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Science and Society.

EVER since men began to live in organised society, in which the law of the jungle was replaced by tradition and custom, there has been speculation as to the past and the future of humanity. There have been those who placed the golden age in the dim past and looked upon the successive stages of human history as years of decay and decline; others have visualised changes in society as cyclic in character; but the idea of progress which has dominated recent social thought is a child of the later eighteenth century, and it was the hope of the unlimited progress of humanity, which illumined the age of Reason in the later eighteenth century. Condorcet spoke of a "science of man," but it was left to others like Comte and Spencer to work out in detail a science of society, which has come to be known as Sociology, whose 'laws' gave the earlier dreams of progress a body and a direction. Under the influence of the great changes of the Industrial Revolution, these early students of sociology conceived of humanity as moving towards a state of things in which industrialism would be the dominant note, and peace among mankind and goodwill towards all would prevail.

This progress was not supposed to prevail among all sections of humanity, nor was it continuous; many believed with Leslie Stephen that "Progress is the rare exception; races may remain in the lowest barbarism or their development be arrested at some more advanced stage; actual decay may alternate with progress, and even true progress implies some admixture of decay." The early years of the twentieth century seemed to deepen the note of interrogation, and the check to the industrial progress of some of the European countries, the rise of Japan, and the uneasy stirrings in their age-long sleep of other Eastern nations roused the apprehensions of Europe. Accordingly more than a quarter of a century ago, Mr. Balfour examined the possibilities of decadence among the advanced nations of Europe and the chances of advance into the vanguard of progress by Oriental peoples, who were till then believed to be static. Mr. Balfour ruled out the latter possibility, holding that "progress is with the West; with communities of the European type." He was of opinion that the progressive character of the nations of the West would be supported and reinforced by the social force that had

come into being, "new in magnitude if not in kind, *viz.*, the modern alliance between pure science and industry." We have been told how fruitful that alliance has been by Mr. Keynes in his striking description of the "extraordinary episode in the economic progress of man constituted by the age which came to an end in August 1914."

Science had no doubt done wonders for the economic progress of men, but the same date that closed the epoch of economic munificence also opened a devastating episode in the history of man, in which science armed man with weapons of terrific capacity for destruction. The War in which thousands of millions of capital and millions of human lives were destroyed was followed by a short period of seeming prosperity and settlement. Then came the great Depression, which revealed another aspect of science in relation to society. Mankind has been living since 1929 in the shadow of this great economic catastrophe, lacking employment and food, not because the bounty of nature has been exhausted nor because science has come to a stop in its progressive control of natural forces, but entirely because social organisation has proved itself incapable of adjustment to the new discoveries of science, which, it has been proclaimed on all sides, has placed abundance beyond dreams for the first time within the reach of mankind. Man has stood helpless, hungry and cold, before the plenty that science has produced for him. Coffee has been thrown into the sea, wheat has been burnt in furnaces, and pigs have been slaughtered by the million, and mankind is starving.

More. If science has held out the promise of plenty on a colossal scale, it also has armed man with deadly weapons that threaten destruction on an equally large scale, and while nations have not yet emerged out of the long-drawn out period of economic depression, they are racing madly along the path of armaments and destruction.

It is clear that scientific discoveries have outrun man's mental and moral capacities, and we are yet a long way from the realisation of the dream of Condorcet, of "the human race freed from all its fetters, withdrawn from the empire of chance, as from that of the enemies of progress and walking with firm and assured steps in the way of truth and virtue and happiness." For a double problem is set to humanity by the progress of science: smooth articulation of scientific discovery with the complex machinery of social life, and the use for human advancement, and not for human destruction, of the increased control over nature that science has been placing in our hands.

II.

Sir Josiah Stamp in his massive address before the British Association deals mainly with the first of these two problems. He does not deal with the influence or effect of science upon society, but with the fact of impact of science upon society: he asks "whether the transition has been difficult and distressing, in painful jerks and uprootings, costly, unwilling or unjust; or whether it has been easy, natural and undisturbing." An important line of enquiry, for "the impact of science will be surprising and painful in the one case and smooth and undamaging in the other." There can hardly be any doubt that there is much "avoidable friction in the reception given to scientific discovery", and this is hardly a matter for surprise since "the training of the scientists includes no awareness of the social consequences of their work, and the training of the statesmen and the administrator no preparation for the potentiality of the rapid scientific advance and the drastic adjustment due to it, no prevision of the technical forces which are shaping the society in which they live. The crucial impact is nobody's business." It may be that society stands to gain on the whole by applications of science to social life, but there is a wastage of human skill, of capital, and a tearing up of social ties and injuries to allegiances of place and kin. The credit and the debit sides of the account have to be carefully studied, but "in this neutral field the specialist scientist and the politician are both amateurs. It has to be covered by each extending his studies, and by specialists who treat impact and change as an area of scientific study."

Sir Josiah Stamp is careful to point out that there are two elements in the situation, which go to reduce the adverse effects of the impact of science upon industry and society. One of these he calls the "balance of innovation", and it consists in the fact that work-saving changes are set off by work-creating changes, as when quite new objects of public demands are invented and bring together "released labour and released purchasing power in the most decisive way." A second

is the natural increase of population which is an excellent shock absorber for a community, since the effects of a new invention in increasing production are met by the increased demand of the larger population. Sir Josiah does not fail to draw attention to the declining population in the Western industrial countries, which will result in this safety valve being no longer available in the coming years. When all is said and done, there is need for "some regulation of the rate of change to an optimum point in the net balance between gain and damage, even assuming that the gains to society as a whole from a rapid advance are ample enough to cover a change for consequential damages." "Perhaps birth control for people demands ultimately birth control for their impedimenta."

III.

Is it possible to modify "the nature of man to meet impact"? "If we must have quanta of stages, the question is their optimum length and character, not merely the regulation of industry and innovation in their tempo, but the education of man and society to pulse in the same rhythmic wave-length or harmonic." This leads to a consideration of the value of social sciences, and Sir Josiah comments on the disadvantageous distribution of resources for research between Physical Sciences and Social Sciences: "We have not begun to secure an optimum balance. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences, or possibly, if resources are limited, a transfer ought to be made from one to the other. Experimental scientists in the older and so productive fields, look askance at the newer borderline sciences of genetics, eugenics and human heredity, psychology, education and sociology but unless progress is made in these fields which is comparable with the golden ages of discovery in physics and chemistry, we are producing more problems for society than we are solving."

What is the line of investigation in these sciences, and what are the directions of human adjustment, to which our expectations should turn? "There must be optimal lines of change which are scientifically determinable. We have seen in a few years that the human or social temperament has a much wider range of tolerance than we had supposed," whether we take speed in transport, limit of direct taxation, or variations in women's dress. "One hesitates to say, therefore, that resistances to scientific changes will be primarily in the difficulty of mental and physical adjustments. But there can be little doubt that with the right applications of experimental psychology and adjusted education, the mind of man would be still more adaptable." What is proposed is "not to change the same man in his life-time, but to make a larger difference between father and son." This can be done by modifying the social environment, for "the environment of one generation can produce a lasting result, because it can affect the environment of future generations. Environments, in short, as well as people, have children. Though education and so forth cannot influence new births in the physical world, they can influence them in the world of ideas (Pigou)."

IV.

Change there must be, though should be mastered by man. But where is change taking us, and how far is the control of natural forces placed in the hands of man helping him to raise himself? "The future of man," remarks Professor Julian Huxley, "if it is to be progress and not merely a standstill or a degeneration, must be guided by a deliberate purpose." It is true that the formulation of an agreed purpose for man as a whole will not be easy, because in spite of the wave of internationalism that swept over the world at the close of the Great War, national animosities are simmering, and within each nation, the cleavage between classes has been sufficiently wide to make much needed economic and social reforms within a nation hard if not impossible. Men have been brought up on a code of conduct based on the supreme interests of the individual, and social instincts are not yet sufficiently powerful in the individual members of a community. Therefore it is of great significance that Sir Josiah should suggest that "the whole body of ethics needs to be re-worked in the light of modern corporate relations." It is interesting to recall in this connection that Mr. Keynes prophesied several years ago that there would be great changes in the code of morals because drastic economic changes would vitiate the social value of hitherto cherished virtues like thrift.

The great task before nations at the present time is to realise their interdependence and the utter futility of the belief that

one community or a section of a community can prosper while the other communities or the other sections are in misery. The bounty that modern discovery enables men to obtain from nature may at last enable them to free themselves from the age-long haunting economic problem, and at last engage in the pursuit of higher values of life. Men are assisted in meeting the call upon them only in part when the technical problems of the impact of science upon society are solved. More is wanted, and that is social control of scientific discoveries for the advancement of human values and not for mutual destruction. It is therefore comforting to read that at the same session of the British Association which listened to the learned President's call for a new technique and a new outlook in the application of science to social life, Sir Richard Gregory condemned the use of scientific research and invention for inhuman ends, and advocated the conservation of social and spiritual values with scientific teaching and research while Sir Daniel Hall called upon men of science to join in the fight for freedom, condemning the entrusting of science, which meant power, to "power-mongers".

Professor S. S. Bhatnagar, O.B.E., D.Sc.

WE have great pleasure in offering Professor S. S. Bhatnagar, our cordial welcome and felicitations.

It will be remembered that in recognition of his valuable investigations of basic importance to the petroleum industry, Messrs. Steel Bros. & Co., Ltd., and Attock Oil Company placed at his disposal in 1934 large sums of money for further researches on petroleum and kindred subjects. In a spirit of disinterested devotion, Prof. Bhatnagar handed over this munificent grant to the Punjab University, which was more or less in the nature of a personal gift made to him by Messrs. Miller and Ward. With the fund thus rendered available, the Syndicate of the University proceeded to establish several research scholarships in the newly inaugurated Department of Petroleum Research.

Encouraged by the results obtained from Prof. Bhatnagar's investigations and anxious to carry them forward, Messrs. Steel Brothers invited Prof. Bhatnagar to visit their Head Office in London last summer in order to discuss with him further schemes of research, and as the result of their negotiations, they have agreed to provide him with an unconditional subvention of Rs. 2,50,000 for financing their five-year programme. In making this offer Messrs. Steel Brothers express the hope that the results of Prof. Bhatnagar's researches will be of great benefit to their industry, and of value to general science.

Prof. Bhatnagar's attitude towards these grants aggregating to Rs. 4,00,000 is similar to that of Dr. E. P. E. Roux who was awarded the Osiris Prize of £4,000 for the discovery of the anti-diphtheria serum, and who made over this amount to the Pasteur Institute in Paris.

The principle underlying Sir M. Visvesvaraya's public advocacy of associating the Indian industries with the scientific research departments of universities is practically adopted by the Syndicate of the Punjab University in accepting the grant of Messrs. Steel Brothers and permitting the head of their Chemistry Department to pursue the researches planned by their conjoint deliberations. The success of any industrial enterprise depends not only on advertisement and sales agencies but also on the closest co-operation of science and industry. The representation of scientific interests, such as those secured by Messrs. Steel Brothers, in the furtherance of their industry ensures a large amount of sympathy and friendliness for the technical staff, as also the appreciation of the difficulties involved in the various operations comprising their business enterprise.

Judging by the happy results already achieved, we have not the slightest doubt that the association established by Messrs. Steel Brothers and the Punjab University will prove mutually advantageous. The public spirit and self-abnegation of Prof. Bhatnagar have justly earned for him the great esteem of his colleagues and the gratitude of the country.

Locusts as an International Problem.

By B. P. Uvarov, D.Sc.
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THE statement that locust swarms recognise no boundaries has become a truism but until recently these vagabond tendencies of locusts served only to accentuate international discord. Reports on locust control published by various governments in most cases refer to the excellent results attained locally and to the futility of local efforts in view of the inactivity of the neighbouring countries. Such statements are sometimes true, but more often they are wholly, or partly, incorrect. In any case, there was often more unity between locust swarms bred in the neighbouring countries, than between their respective government departments, to the obvious advantage of the insect.

The necessity for co-operative action against the common enemy has been, of course, realised, but this co-operation is usually wrongly conceived. It is often argued that a locust invasion affecting several countries can be brought to an end, if only all these countries would agree to adopt vigorous control methods and to see that they are carried out. Painful experience of the last invasion of the African continent has proved beyond doubt that an outbreak, once it has been permitted to develop on a really large scale, is beyond practical possibility of being controlled. This is due to the enormous extent of invaded areas, many of which are sparsely, or not at all, populated. Further, the rate of multiplication of locusts is such that when only a small percentage of swarms of one generation escape destruction, the number of their progeny will be just as great as before, or even greater. The only practical policy at the height of an invasion is to concentrate all the efforts on the defence of standing crops. This defensive policy can be very effective, but it does not contribute to the solution of the problem.

The problem must, obviously, be approached from a different direction. It has been always known that locust outbreaks are not a permanent phenomenon, but there is a certain irregular periodicity in their development. Moreover, they always arise first in somewhat restricted areas and only gradually the swarms spread over whole countries and continents. These two points suggest that it should be possible to prevent widespread invasions by concentrating the early efforts in the areas which can be regarded as original sources of the swarms. This conception remained on a purely theoretical basis until recently when the advances made in the study of locust biology and of the factors governing outbreaks have provided a firm foundation for formulating a practical policy of the prevention of locust outbreaks.

The fact of primary importance in this connection was the discovery of the phase variation in locusts. This phenomenon consists in the ability of locusts to develop in two forms, or phases, the solitary and the gregarious, which differ widely in their colouration, structure, physiological reactions and therefore, habits. A thorough experimental study of phase variation commenced only quite recently, but there has already accumulated a considerable amount of information on them, which it would be out of place to review here. It is sufficient to say that the majority of workers on the problem agree that the gregarious phase can be produced in any locust by breeding the larvæ in a dense crowd, *i.e.*, the density of population within a restricted area is the factor causing the transformation. The result of this transformation is a compact swarm of gregarious locusts differing from the original solitary ones in greater rate of activity and in the striking tendency to remain in close proximity to each other which ensures the existence of a swarm as a single unit.

If it is not difficult to obtain any desired density of the initial locust population in experimental cages, the question arises how can a crowding occur under natural conditions in the field. Suggestions have been made that a natural population of solitary locusts may become sufficiently dense to start the transformation merely as a result of a general increase in the numbers of locusts. Such a phenomenon,

however, has never been observed, while, on the other hand, definite observations have been made on the mechanism of phase transformation in the field under somewhat peculiar conditions. It has been found, that the initial concentrations of solitary locusts may, and do, occur as a result of seasonal fluctuations in the extent of favourable habitats. It is well known that locusts, like all other Acrididæ, are highly selective with regard to the type of vegetation. The result is often a patchy distribution, the locusts occurring only in small areas with favoured vegetation. If we imagine, for example, a vast desert area with scattered depressions where grasses grow, these depressions will harbour locusts, while none will be found in the intervening desert. The extent of such grassy areas would increase in years with good rains, and their locust population will also increase. If this favourable period is followed by a year of poor rains, the areas available for locusts will decrease at once, and they will become crowded in the depressions as if they were in cages. A transformation into the gregarious phase will inevitably follow, and the resulting swarms will migrate far and wide, reaching without difficulty the regions suitable for reproduction.

This is a theoretical scheme merely because it is generalised, but it is based on actual observations on the Desert Locust (*Schistocerca gregaria*, Forsk.) and on the Madagascar Migratory Locust (*Locusta migratoria capito*, Sauss.). Studies on the ecology of other locusts suggest that the process of transformation into the gregarious phase is always caused by the instability of their habitats when the latter are not continuous but patchy. It is, therefore, only a matter of intensive ecological research to discover the preferred habitats and the causes of fluctuations in their extent in each particular case.

Such research should, of course, always cover the whole distribution area of a particular locust species, and it would be futile to restrict it to a single country. Moreover, although the so-called outbreak areas, *i.e.*, localities where the initial transformation into the gregarious phase can occur, may be found in one country, the swarms produced there will eventually spread beyond its limits. Therefore, all countries subject to invasions by the particular locust have an immediate interest in the discovery of outbreak areas, and the investigations directed to that end should be organised internationally.

This principle has been actually adopted in the recent investigations organised in Africa by a number of governments interested in the locust problem. It was at once realised that some centralisation of research would contribute greatly to the success of the work and the participating governments agreed that the Imperial Institute of Entomology in London should act as the International Centre for Anti-Locust Research. The first important function of the Centre was to organise a regular collection of the information on breeding and movements of locusts over the whole territory of Africa and Western Asia. A system of monthly reports was organised and every country regularly submits such reports accompanied by maps. These local reports are summarised and monthly maps for the whole invaded area are prepared, so that the development of the outbreak can be followed step by step. As a result of this system, it became possible to reconstruct the whole history of outbreaks of three locust species, and to obtain general indications as to the probable original sources where the outbreak of each of them arose.

These general indications served as a starting point for field ecological research by special entomologists. Detailed plans for the field investigations prepared in each country are discussed at periodical International Locust Conferences, so that the work is distributed according to the possibilities of each country, and no overlapping occurs. The results are also reported to the Conference, while the field investigators keep in touch with the International Centre during their work, and are informed of any developments occurring in other countries. The functions of the International Centre include regular bibliographical work, so that anything published on locusts is brought to the notice of field workers. Advice on various points connected with the study of locusts is also supplied by the Centre, both to field entomologists, and to the already numerous workers in universities, etc., who take locusts as the objects for their researches.

Perhaps, the most interesting feature this international organisation is that

came about without complicated diplomatic agreements, simply as a result of a soundly conceived policy, which received a willing support from all the governments concerned with the locust problem.

The results already achieved by the international organisation can be described as exceeding expectations. Indeed, with regard to one of the locust species under investigation, the African Migratory Locust, (*Locusta migratoria migratorioides*, Reh. & Frm.), it has been definitely proved that its recent invasion of the greater part of the African continent originated in a single area on the Middle Niger in the French Sudan. Practical schemes for establishing the permanent control of that area are now being prepared and it can be hoped that they will be effective in the prevention of future invasions.

Another locust of exceptional importance in Africa is the Red Locust (*Nomadacris septemfasciata* Serville), and three of its outbreak areas have already been discovered, and will be taken under control. Investigations are continuing to find other possible sources of outbreaks.

With regard to the Desert Locust, the invasion of which covers a great part of Africa and most of Western Asia, some good practical results have also been obtained. It has been found that outbreak areas of this species are found not in inner deserts, but on desert sea-coasts where peculiarly unstable ecological conditions are often favourable for the formation of the gregarious phase. Some of the outbreak areas have been definitely located on the coasts of the Red Sea in the Sudan and Arabia, and Indian entomologists have succeeded in defining potential outbreak areas on the Mekran Coast. However, there still remain extensive coastal tracts in Iran, Eastern Arabia, Eritrea and Mauretania where field investigations are either in progress, or should be carried out shortly, if a guarantee against future invasions is to be reached.

This, necessarily very brief, account of the international anti-locust work should be sufficient to show that at least some hope can be entertained for a permanent solution of the locust problem. This has been achieved by unselfish co-operation of several countries, by a carefully planned general scheme of investigations and by centralisation of all the information on the problem in a single, internationally recognised, central institution working for the common benefit. It would not be an exaggeration to say that the international anti-locust research may be regarded as a unique example of determined international effort towards the solution of one of the greatest entomological problems. Whether this effort will be crowned with ultimate practical success, depends entirely on the continued international unity in dealing with the problem even when it will lose its present acuteness. The governments were induced to adopt a far-reaching anti-locust policy because of great economic losses caused by the last outbreak. When the outbreak subsides, there is danger that at least some of the governments may consider it more economical to do nothing and hope for the best. Should this happen, the whole carefully planned anti-locust scheme will be threatened with a collapse and the money and energy spent during the last few years will be largely wasted. The occurrence of another outbreak is only a question of time unless the present policy of prevention is rigorously carried to its logical end.

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Enzymes in Relation to Cancer.

By Dr. Ing. Arnulf Purr.

(*Biochemical Institute of the German Technical High School of Prague, Czechoslovakia.*)

WARBURG'S researches[1] have shown that the question of the character of malignant growths is primarily a metabolic problem. A consideration of the established facts lead to the conclusion that metabolic processes of the cancer cells bear a significant relationship to the total metabolism of the healthy organs closely. Future research should consequently be directed to discover the functional differences between the metabolism of the entire tumour organism, and that of the healthy organism, with a view to elucidate the causes of the pathological behaviour of the cancer cells.

Since the course and intensity of the metabolic activity in the tumour and in the tumour afflicted organism, is intimately bound up with the enzymatic processes, it is obvious that for understanding the character of the malignant growth, it is essential to obtain a clear knowledge of the various types of enzymes and the mechanism of their activations. The results of experiments carried out on various proteolytic enzymes, described here, are intended to act as a guide for further experiments in the same direction.

The intracellular proteolytic enzymes were studied in the tumours—carcinome and sarcome, produced experimentally, and in the organs of cancerous and healthy animals. The pathological-anatomical analysis and the fixation of their proportions in the total substance, served as a basis for the comparison of the growth-changes in the histologically differing elements of the tumour-tissue.* Of the enzymes examined, cathepsin shows a significant decrease with the ageing of the tumours (increase in the necrotic tissue) (*cf.* Fig. 1). One can consequently conclude that this enzyme is confined almost exclusively to the parenchymatous tissue. The arginase, on the other hand, behaves differently; the quantity increases considerably as necrosis proceeds. It appears, that the arginase is to be found principally in the necrotic tissues and only to a small extent in the growing tissues. These facts, which were established by Waldschmidt-Leitz, McDonald and collaborators[2] (1933) led the author to investigate

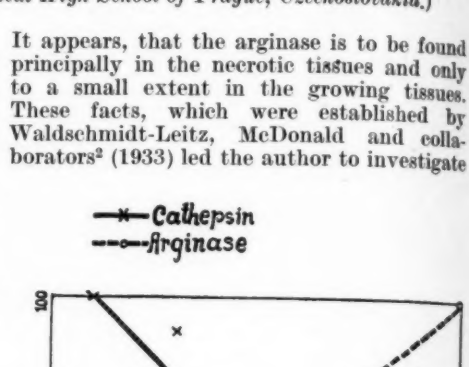


Fig. 1.

further, the general distribution of the enzymic systems in cancerous and healthy animal tissues. In the first instance, attention was directed to the study of the enzymic contents in the organs of healthy, cancerous and cancer-immune animals.

Cathepsin studies with albino rats showed (A. Purr, 1934)[3] that in healthy albino rats (ordinary untreated laboratory rats) the cathepsin content of the liver (measured as full-activity with cysteine as activator) was uniform; the muscle-tissue was found to be practically free from these enzymes. Changes, worthy of note, occur only after these rats have been successfully inoculated

[1] O. Warburg, *On the Metabolism of Tumours*. J. Springer, Berlin, 1926.

* We distinguish between parenchymatous, fibrous and necrotic proportional parts.

[2] E. Waldschmidt-Leitz, E. McDonald and collaborators, *Z. Physiol. Chem.*, **1933, 219,** 115.

[3] A. Purr, *Biochemie J.*, **1934, 28,** 1907.

with transplantable rat—sarcome Philadelphia I; the cathepsin content of the liver increases considerably and the muscle-tissue exhibits appreciable catheptic activity. It should be noted that the increases of the catheptic enzyme concentration in the liver and the muscle-tissue do not run parallel with the decrease of the same in the ageing cancerous tissue as measured by the increase of the necrotic cells); on the contrary all indications point to the fact that there is a disturbance in the enzymatic metabolism. Edelbacher and Merz[4] were able to establish a similar behaviour in arginase, proving that the presence of this enzyme was to be found in the muscle-tissue of animals which had been successfully inoculated with transplantable cancer; they found however no arginase in the muscle-tissue of normal, healthy animals. It may be concluded, therefore, that the increase in the quantity of arginase points to a specific factor of growth, which like the disturbed glycolysis (known through the research work of Warburg[1]) is characteristic of a malignant growth; the increased catheptic activity in the liver and muscle-tissue is also a characteristic sign of a specific growth-factor. A further noteworthy observation may be mentioned in this connection; the albino rats that had successfully resisted the inoculated tumour had from the very beginning more cathepsin in the liver and in the muscle-tissue than the ordinary untreated laboratory rats. Similar experiments on the kidney-phosphatase of cancer-resistant rats led F. Kohler[5] to analogous results. It appears therefore that a higher but well regulated enzymic metabolism is characteristic of cancer-immune organisms. These important observations indicate a successful biochemical method of diagnosing cancer in its incipient stages, a so-called early diagnosis.

For a proper understanding of the change of the enzymatic metabolic processes in the tumour cells in relation to the organisms which are resistant against inoculation, the study of the activation phenomena for the individual enzymes is important, not only as regards their characterisation but also as regards their collective and individual disturbance within the organism as a whole. Such studies should prove particularly valuable for purposes of early diagnosis.

The study of these activat n changes, carried out on the intercellular proteolytic enzymes cathespin and papain, required a number of preliminary tests,[6] to which special attention should be drawn since they led to the standardisation of a method for the determination of physiologically active substances in the blood,[7] the application of which rendered possible a comparison between the intracellular metabolism of healthy and cancerous organs. As a measure of the concentration of such active principles, the activation of papain brought about by SH-groups has been adopted (*cf.* Fig. 2).

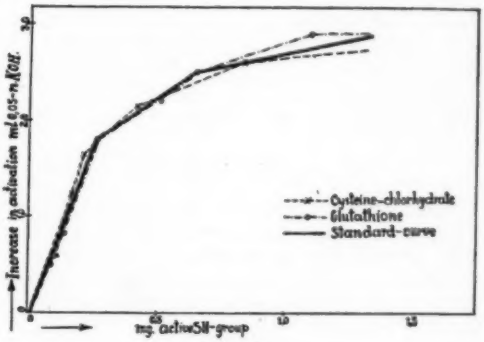


Fig. 2.

The progress of the activation of papain through cysteine hydrochloride or possibly glutathione has proved useful in estimating the latter substance on the basis of the SH-group (*cf.* Fig. 3). The employment

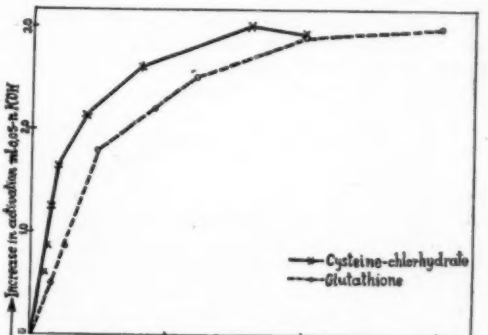


Fig. 3.

[4] Edelbacher and Merz, *Z. Physiol. Chem.*, **1927, 171,** 252.

[5] F. Kohler, *Z. Physiol. Chem.*, **1934, 223,** 38.

[6] A. Purr, *Biochem. J.*, 1935, **29,** 5-20.

[7] A. Purr, *Z. Physiol. Chem.*, **1934, 228,** 198.

of this procedure for comparing the activating effects produced on the papain by blood from healthy and from cancerous organisms, showed that the blood from the latter possessed a lower activating capacity than the blood from healthy organisms (*cf.* Fig. 4).

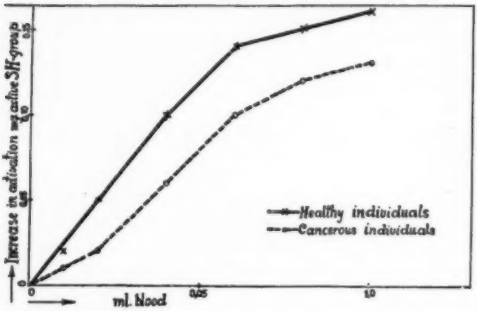


Fig. 4.

A most striking point in the result of this experiment and one worthy of particular note is that the glutathione present in the blood can only participate to a slight extent in the total capacity of activation of papain ; for, the activating effect does not correspond quantitatively to the amount of glutathione found in the blood. Consequently the greater part of the activation must have been produced by auxiliary activating systems present in the blood, a circumstance which facilitates the recognition of such physiologically active systems in the blood.

It is proposed to carry out the experiments on a more extensive scale and the results obtained so far lead to the belief that an early diagnosis of cancer is possible by the study of activation phenomenon.

The differences in the behaviours of the cathepsin and arginase referred to at the commencement of this article, were pointed out by Waldschmidt-Leitz, McDonald and collaborators[2] and was later confirmed by the author[3] working with histologically uniform structural elements of the tumour-tissue. It appears that a young, vigorously proliferating cancer-tissue, free from necrosis, is characterised by a high cathepsin and a low arginase concentration. This is especially true in the case of melanomes in horses (also included in the series of experiments[8]) and on account of its striking behaviour, this material is worthy of further tests.

These findings possessing profound physiological significance lead to the conclusion that in the cancerous cells, the synthesis of the albuminous covering, in which process, cathepsin participates, is delayed. There is no ground for the supposition that in the ageing cancerous tissue the autolytic cell-destruction is related to the catheptic activity ; it is much more probable that the arginase is connected with these autolytic processes.

Further observations are necessary for elucidating the mechanism of growth of malignant swellings and the influence which such swellings exert on the organism. The relations existing between the effects of the intracellualr enzymic systems arginase and cathepsin, and the typical respiration ferments, such as the aerobic dehydrases, of which the xanthine dehydrase[6] may be specially mentioned, deserve careful investigation.

[8] A. Purr, *Z. f. Krebsf*, 1935, **41**, 483.

The Elephanta Caves.

THE rock-cut sculptures at Elephanta, like others in the different parts of the country, are decaying under the influence of weather and moisture, apart from the mantle of vegetation. The decomposing effects of the latter due to the exudation of organic acids have been undermining these mural decorations for generations, and several attempts have been made to arrest the process of disintegration, and preserve their architectural beauty. The Government of India, recognising the supreme importance of protecting these historical works of art from the ravages of the elements, have appointed a strong Committee to investigate the causes of deterioration and to suggest remedial measures. The Committee is composed of Mr. J. F. Blackiston, Director-General of Archæology, Dr. S. S. Bhatnagar, Professor of Chemistry, the Punjab University, Mr. A. Croad, Superintending Engineer, Central Public Works Department, and Mr. S. N. Gupta, Principal, Mayo School of Arts. The Committee will commence their investigations in November.

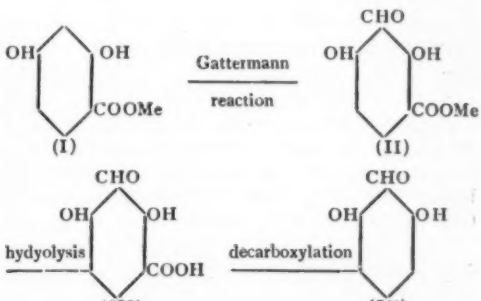
LETTERS TO THE EDITOR.

CONTENTS.

A Synthesis of γ-Resorcylaldehyde.

METHYL β-resorcylate (I) does not undergo the Gattermann reaction under the usual conditions. It is found, however, that under special conditions, *viz.*, in the presence of anhydrous aluminium chloride dissolved in dry ether[1] the reaction proceeds very smoothly and a high yield of the aldehyde-ester (II) is obtained. The aldehyde group is found unexpectedly to enter exclusively the usually inaccessible γ-position in the resorcinol nucleus. This welcome observation has made possible a simple synthesis of γ-resorcylaldehyde, which has been synthesised in the following manner:—

Methyl 2 : 4-dihydroxy-3-aldehydo-benzoate (II), the product of the Gattermann reaction on methyl β-resorcylate (I) was hydrolysed almost quantitatively under properly regulated conditions by cold dilute alkali (48 hrs.) to the free acid (III). The acid (III) on decarboxylation by heating with water in a sealed tube at 100–110° gave γ-resorcylaldehyde (IV), m.p. 155–156° in a fair yield (30%).



γ-resorcylaldehyde has been very recently synthesised by a different method from 2-acetyl resorcinol through a number of stages.[2]

The constitution of the aldehyde ester (II) was conclusively established by Clemmensen-reduction followed by partial methylation, when known methyl 2-hydroxy-3-methyl-4-methoxy benzoate of proved constitution[3] was obtained. A number of derivatives and related compounds have also been prepared.

A detailed account of this investigation will shortly be published elsewhere.

R. C. SHAH.
M. C. LAIWALLA.

Ismail College, Andheri, Bombay,
and
Royal Institute of Science, Bombay,
October, 1936.

[1] Shah, *Curr. Sci.*, 1934, 157.
[2] Limaye, *Rasayanam*, 1936, **1**, 13.
[3] *Cf.* Jones and Robertson, *J.*, 1932, 1689.

Action of Thionyl Chloride on Esters of Salicylic Acid in the Presence of Catalysers.

COPPER or its chlorides work as catalysers for the interaction between sulphur mono- or di-chloride and esters of salicylic acid but fail to behave similarly when thionyl chloride is used. In the latter case they (*i.e.*, copper or its chlorides) are required in molecular proportions. These reactions were studied by Hirve, Jadhav and Chakradeo[1] and products of the type $(C_6H_3OH.COOR)_2S$ were obtained, where R represents CH_3, C_2H_5, etc. The explanation given by these authors was that thionyl chloride was first converted into sulphur monochloride, sulphur dichloride and sulphur dioxide, copper also taking part in the reaction. The former two then reacted with the esters of salicylic acid as mentioned in the beginning.

In search of catalysers for the interaction between thionyl chloride and esters of salicylic acid, almost all the metals or their chlorides were tried. Out of them zinc dust, iron dust and the chlorides of zinc, iron, tin, bismuth and antimony work satisfactorily, 0·1 to 0·2 g. being sufficient.

The most suitable proportion for the reaction was found to be two molecules of thionyl chloride to two molecules of the ester, though it was found that out of the two molecules of thionyl chloride, only one was actually used up, the second one being swept away by the hydrochloric acid gas evolved.

The reaction took place with copious evolution of hydrochloric acid gas and was over within about six hours at room temperature. The resulting products were identical with the thioethers obtained by Hirve, Jadhav and Chakradeo. In no case did any sulphur precipitate.

As only one molecule of thionyl chloride is required in the reaction for every two molecules of the ester and as hydrochloric acid gas is evolved, the reaction seems to have taken the following course:

$$SOCl_2 \longrightarrow S + O + 2\,Cl,$$

the two chlorine atoms going with the two hydrogen atoms from the two benzene rings, the sulphur atom taking the place of these two hydrogen atoms and the oxygen atom being liberated as such, *i.e.*,

$$2\,C_6H_4\cdot OH\cdot COOR + SOCl_2 \longrightarrow (C_6H_3\cdot OH\cdot COOR)_2S + 2\,HCl + O.$$

The oxygen atom was searched for in the form of oxygen gas or in the form of sulphuryl chloride, *i.e.*,

$$SOCl_2 + O \rightarrow SO_2Cl_2,$$

but it could not be detected in any of these forms. Hence it is possible that it is used up in oxidising the organic substances whereby the yields were always found to be not more than 73 per cent.

The above explanation amounts to the same thing as saying that the catalysers act as double catalysers; firstly they convert thionyl chloride into sulphur dichloride and oxygen, and then bring about the condensation between sulphur dichloride and the esters of salicylic acid. The action of sulphur dichloride on the methyl, ethyl and phenyl esters of salicylic acid as well as free salicylic acid was tried in the presence of these very catalysers and the same products were obtained also with evolution of hydrochloric acid. This proves the correctness of the view mentioned in the beginning of this paragraph.

Free salicylic acid does not react with thionyl chloride in the same way as with sulphur dichloride, perhaps because thionyl chloride exerts a dehydrating action on the hydroxy and carboxylic groups which are in ortho position to each other. For this reason the carboxylic group requires to be protected by esterification. As no dehydrating action is exerted by sulphur dichloride, such a protection becomes unnecessary in its case.

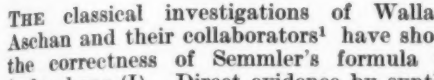
J. A. KUNDARGI.
Y. M. CHAKRADEO.
S. V. SHAH.

Rajaram College,
Kolhapur,
September 26, 1936.

[1] *J. Univ. Bomb.*, 1933, 128; *J. Ind. Chem. Soc.*, 1934, 551; and *J. Am. Chem. Soc.*, 1935, 101.

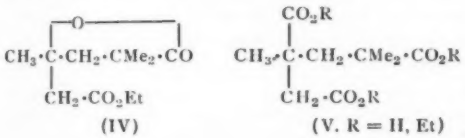
Experiments towards the Synthesis of *Iso*fenchone and Its Degradation Products.

THE classical investigations of Wallach, Aschan and their collaborators[1] have shown the correctness of Semmler's formula for *iso*fenchone (I). Direct evidence by synthesis, however, has been wanting for the constitution of either *iso*fenchone or any of its products of degradation, *e.g.*, *iso*fenchocamphoric acid (II). The present investigation has been undertaken with a view to filling such a gap, and a preliminary report is now made of the results obtained so far.

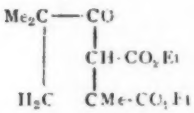


(I) (II) (III)

Ethylmesitonate[2] (III) (ethyl $\alpha\alpha$-dimethyl lævulate), b.p. 108–110°/25 mm. (Semicarbazone, m.p. 154°; 2 : 4-dinitrophenylhydrazone, m.p. 98°) has been condensed with zinc and ethyl bromoacetate to yield the lactone of ethyl β-hydroxy-$\beta\delta\delta$-trimethyl adipate (IV), b.p. 137–38°/6 mm. The lactonic ester adds KCN at 220° and the intermediate cyanoester yields on hydrolysis with concentrated HCl $\beta\delta$-dimethylpentane-$\beta\delta\epsilon$-tricarboxylic acid (V, R = H), m.p. 172°. The corresponding ester (V, R = Et) prepared by alcohol vapour method with



(IV) (V. R = H, Et)



(VI)

concentrated H_2SO_4, boils at 125–128°/1–2 mm. The constitution of the compound (VI) obtained from the ester (V) by cyclisation is being confirmed. Further work on the synthesis of *iso*fenchone from (VI) is in progress.

My thanks are due to Prof. P. C. Guha for his interest in the work.

S. K. RANGANATHAN.

Department of Organic Chemistry,
Indian Institute of Science, Bangalore,
October 1, 1936.

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[1] Wallach, *Annalen*, 1908, **362**, 191; **363**, 5.
Wallach and Homberger, *Ibid.*, 1909, **369**, 97.
Aschan, *Annalen*, 1912, **387**, 1.
Sandelin, *Ibid.*, 1913, **396**, 285.

[2] Pinner, *Ber.*, 1882, **15**, 529; *cf.* Anschutz and Gillet, *Annalen*, 1888, **247**, 99.

A Volumetric Method for the Estimation of Moisture.

OF the two main methods, oven drying and distillation with an entrainer, available for the determination of moisture in substances such as starch and cotton, the former is not always applicable on account of the possibility of decomposition. Thus, except for precautions in the weighing of the highly hygroscopic bone-dry cotton, the moisture content of cotton may normally be estimated by drying in an oven to constant weight, but the method is unsuitable in the case of cotton which contains certain kinds of extraneous matter or has undergone considerable degradation.

For these and other reasons the Marcusson procedure[1] of distilling the substance with a liquid such as toluene or xylene and reading the volume of the water directly has become increasingly popular. This method, however, has not been free from criticism with regard to the time involved, the choice of the entrainer and the entanglement of condensed water. According to Tate and Warren,[2] who have devised a new apparatus, the comparatively satisfactory types of apparatus due to Friedrichs,[3] and to Bidwell and Sterling[4] both lead to inaccurate results. A new moisture tube has also been recently described by Alexander.[5] The extensive literature on moisture estimation apparatus would appear to point to the practical difficulties of the method, notably the removal of water drops from the inside of the condenser; as a result an "additive apparatus correction constant"[5] seems unavoidable. A variation of the process[6] involving the dehydration of the

distillate with anhydrous copper sulphate and assaying the increase of weight of the latter has given low values in our hands.

In the present method the distillate is led into a known volume of a standard mixture of acetic anhydride and pyridine (1 : 3); when the hydrolysis is complete, the excess acetic anhydride is converted into an equivalent amount of acetic acid and acetanilide. The whole is then made up to a convenient volume and an aliquot part titrated against alkali. If x molecules of acetic anhydride were taken and the substance contained y molecules of water, the acetic acid finally obtained is $(x + y)$ molecules; since x is known, the value of y follows. The accuracy of the method is indicated by the fact that 1 c.c. of normal caustic soda solution corresponds to 0·018 g. of water, the problem resolving itself into the estimation of acetic acid in acetic anhydride.[7]

While a water-immiscible liquid is essential for the Marcusson procedure, a solvent such as dioxane, which is miscible with water and forms an azeotropic mixture containing 20% water and boiling at 86·8°/742 mm., can be conveniently employed for the hydrolytic method. Dioxane, however, needs to be carefully purified since ethylene acetal and other impurities in technical dioxane interfere with the estimation.

N. C. MITRA.
K. VENKATARAMAN.

Department of Chemical Technology,
The University, Bombay,
September, 1936.

[1] Marcusson, *Mitt. aus dem Konigl. Materialprufungsamt*, 1904, **48.**

[2] Tate and Warren, *Analyst*, 1936, **61**, 367.

[3] Friedrichs, *Chem. Ztg.*, 1929, **53**, 287.

[4] Bidwell and Sterling, *J. Assoc. Off. Agric. Chem.*, 1924, **8**, 295.

[5] Alexander, *Ind. Eng. Chem. Anal. Ed.*, 1936, **8**, 314.

[6] Migray, *Ind. Eng. Chem. Anal. Ed.*, 1935, **7**, 348.

[7] Menschutkin and Wasiljew, *J. Russ. Phys. Chem. Soc.*, 1889, **21**, 190; "Report of International Glycerol Commission," *Analyst*, 1911, **26**, 316.

Richmond, *Analyst*, 1917, **42**, 133.

Rosenbaum and Walton, *J. Amer. Chem. Soc.*, 1930, **52**, 3366.

Linkage between the Blackish Purple of Sheath and Glume, and Nucellar Brown in Sorghum.

THE grains of grain sorghum are mostly naked and lack the protection of enclosed glumes. Such protection is afforded in part by the seed coats (pericarp) which may be white or coloured. The colours may be degrees of yellow, red[1] or brown.[2]

Some varieties of sorghum possess a nucellar layer[3] just above the aleurone layer. This layer is pigmented and is of a reddish brown colour. Lying under the mesocarp which is starchy and white, this nucellar colour is masked. Nevertheless, according to the thickness of the mesocarp this underlying "vinaceous drab" (Snowden)[4] imparts a violet tint in the white chalky grained varieties, most noticeable in the variety feterita. This nucellar colour is usually absent in the Indian Durra group of sorghums. It is present in many African sorghums and is most marked in the *caffra* sub-series of sorghum.[4] In *Sorghum caudatum*, Stapf. it finds its best representation and expression.

Regarding the nucellar layer Snowden[4] writes as follows:—"The colour in the grain may be confined to the outer pericarp or it may be absent there but present in the nucellar-layer, or again it may be present in both regions. In the first case the coloured part is removed by husking the grain and the colour of the flour is not affected. In the other two cases, however, the colour present in the nucellar-layer cannot readily be separated from the flour and such grains produce a dirty coloured flour which is less esteemed for some purposes, such as making cakes or bread."

Almost all the varieties with brown nucellus are borne on plants whose leaf sheaths and glumes are blackish purple. The reddish purple leaf-sheaths and glume is largely in evidence in the Durra group of Indian sorghums. It has been noted that in this group there is an absence of nucellar brown.

The reddish purple pigment in the leaf sheath and glume has been shown to be dominant to the blackish purple.[5] A factor Q is present in the former and absent in the latter. In crosses between varieties having nucellar brown and those not having them, the presence of nucellar brown has proved a simple dominant to its absence.[6] Thus a reddish purple leaf-sheath and glume

and nucellar brown are dominant to a blackish purple leaf-sheath and glume and absence of nucellar brown, respectively.

An interesting experience is met with when varieties with a blackish purple leaf-sheath and nucellar brown are crossed with varieties having a reddish purple leaf-sheath and no nucellar brown. The first generation plants have both the dominant characters, reddish purple leaf-sheath and nucellar brown. In the second generation instead of the 9 : 3 : 3 : 1 ratio which the independent shuffling of these characters should give, there occurs the 2 : 1 : 1 : 0 ratio of double dominants, and parental groups, and an absence of the double recessive group. This shows that the gene *q* determining a blackish purple leaf-sheath is linked to the gene producing nucellar brown.

In a previous paper[7] the linkage between the *Qq* (factors for leaf-sheath and glume colour) and *Bb* (factors for brown colour in dry anther and grain) has been reported. In the present instance it is the brown nucellus below the pericarp instead of the brown-wash on the pericarp. Both these manifestations of brown colour have this in common that they are linked to the *q* factor responsible for the blackish purple pigment on the leaf-sheath and glume.

A number of crosses between these African races and Indian races are under examination at the Millets Breeding Station, Coimbatore, and a fuller paper embodying the results will be published shortly.

G. N. RANGASWAMI AYYANGAR.

Agricultural Research Institute,
Coimbatore,
October 6, 1936.

[1] *Ind. Jour. Agr. Sci.*, 1933, **3**, 594–603.
[2] *Ind. Jour. Agr. Sci.*, 1934, **4**, 81–89.
[3] *Jour. Agr. Res.*, 1928, **37**, 577–588.
[4] J. D. Snowden, *The Cultivated Races of Sorghum*, 1936.
[5] *Ind. Jour. Agr. Sci.*, 1933, **3**, 589–594.
[6] *Jour. Agr. Res.*, 1924, **27**, 53–64.
[7] *Ind. Jour. Agr. Sci.*, 1934, **4**, 90–95.

Some Observations on the Ovule and Embryo-sac of *Sonneratia apetala* Ham.

A FEW observations on the embryology of *Sonneratia apetala* were made by Karsten[1] as early as 1891, but his work is rather fragmentary and also erroneous in some points. A re-examination of this species has therefore been undertaken in connection with the writer's work on the embryology of the Sonneratiaceæ.[2]

Ovule.—The ovules are numerous, anatropous, two-integumented and possess a fair amount of nucellus. Both the integuments take part in the formation of the micropyle. The nucellus does not show a strand of specially differentiated cells in the chalazal region as seen in *Duabanga sonneratioides* and some members of Lythraceæ,[3] but along with the ovule it is markedly bent in this dart towards the raphe.

Embryo-sac.—The primary female archesporium usually extends to more than one cell and more than one megaspore mother cells have been occasionally observed. Usually only one of them develops further. It cuts off a parietal cell, which by subsequent divisions gives rise to a 5–6 cells' thick parietal tissue above the embryo-sac. The formation of linear tetrad of megaspores is similar to that seen in *Duabanga sonneratioides*, and the chalazal megaspore is the functional one. It develops into the 8-nucleate embryo-sac after three successive free nuclear divisions in the normal manner. The mature embryo-sac (after the fusion of the polar nuclei) is 4-nucleate due to the early degeneration of the antipodals, just as in *Duabanga sonneratioides*[3] and Lythraceæ. It is a long and narrow structure but even then it has never been seen to reach the epidermis at the micropylar end of the nucellus after crushing the parietal tissue as stated by Karsten.

The structure of the synergids and egg conforms to that observed in *Duabanga sonneratioides*. The polar nuclei meet at about the middle of the embryo-sac, move upwards and finally fuse with each other near the egg-apparatus.

J. VENKATESWARLU.

Department of Botany,
Benares Hindu University,
September 24, 1936.

[1] Karsten, G., *Bibl. Bot.*, 1891, 22 (as cited by K. Schnarf in *Vergleichende Embryologie Der Angiospermen*, 1931).
[2] Venkateswarlu, J., *Curr. Sci.*, 1936, **4**, No. 10.
[3] Joshi, A. C., and Venkateswarlu, J., *Proc. Ind. Acad. Sci.*, B, 1936, **3**, 5.

Nucellar Polyembryony in the Rutaceæ.

NUCELLAR polyembryony had been reported in two genera of the Rutaceæ, *Citrus* and *Zanthoxylum*,[1] and recently a third genus *Murraya*,[2] was added to this list. *Citrus* and *Murraya* belong to the tribe Aurantieæ and so it was suggested by Dr. M. A. Sampathkumaran that a further study of some more species of the Aurantieæ might yield interesting results. The present investigation was then undertaken with a view to examine a few local species of the above tribe.

Since *M. Kœnigi* Spreng had been reported to show nucellar polyembryony, another species of the same genus, *M. exotica* Linn., was examined. Out of a total of about 300 ripe seeds examined, the presence of more than one embryo was noticed in only four cases. The latter were almost always shrivelled in appearance, the individual embryos themselves being small and ill-developed. Recently another batch of about 300 seeds was examined but polyembryony was found in only one case. A large number of young ovules was sectioned and examined, but only a single case of nucellar embryogeny was observed, obviously due to the rarity of the phenomenon. The two embryos found here were just two groups of abnormally enlarged nucellar cells (Fig. 1).

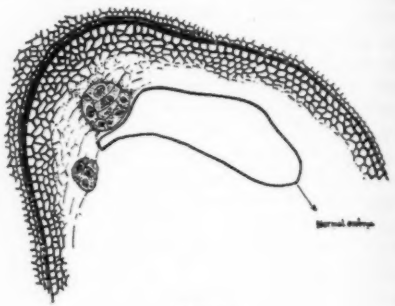


Fig. 1.

Long. Section of ovule of *M. exotica*. Egg-embryo shown in outline.

Aegle Marmelos Correa was the next plant investigated. Though a large number of ripe seeds was examined, not a single case of polyembryony was seen. But on examining serially sectioned preparations of a large number of young seeds, two cases of nucellar embryos were noticed (Figs. 2*b* and 3). In both these cases the nucellar embryo is extremely small when compared with the normal egg-embryo by its side (Fig. 2*a*).

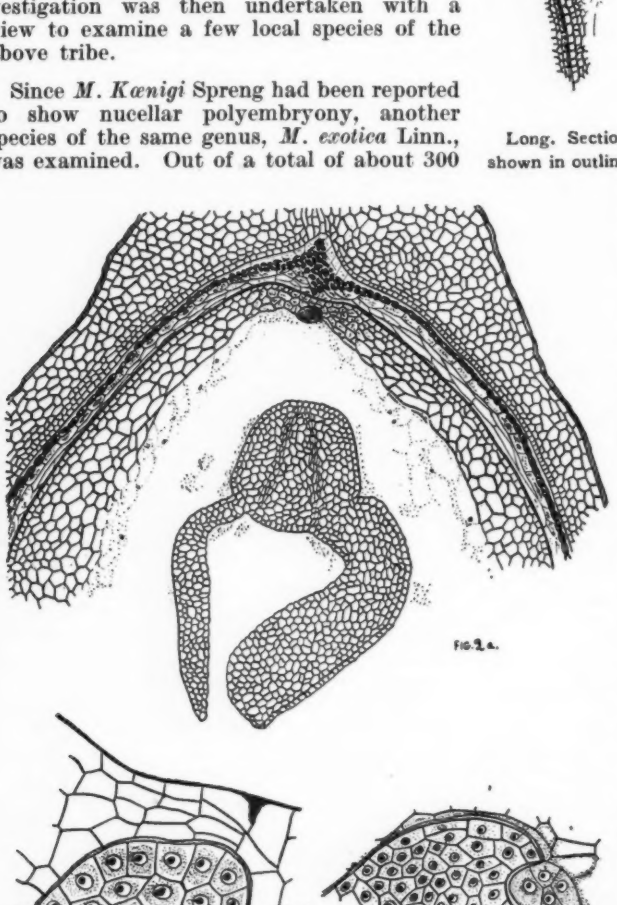


Fig. 2*a*. Long. Section of ovule of *Aegle Marmelos*. The nucellar embryo is imbedded in the nucellus near the micropyle.

Fig. 2*b*. Nucellar embryo of Fig. 2*a* enlarged.

Fig. 3. The small nucellar embryo and part of the curved beak-like suspensor region of the normal embryo.

A large number of seeds of *Feronia elephantum* Correa was examined but without finding any case of polyembryony. A few tricotyledonous embryos were found, but their development was not studied. A few ovules were serially sectioned and examined but no clear case of nucellar embryogeny was seen.

Thus two more species of the Rutaceæ, including another genus, are found to show this interesting phenomena. Nucellar embryos are very rarely found in *Aegle* and even then they seem to stop development at a very early stage, whereas in *Citrus* and *Murraya* the nucellar embryos compete strongly during development with the normal embryo. It is probable that we see within the Aurantieæ a sort of progression beginning with the origin of nucellar embryogeny in a form like *Aegle*, leading to forms like *Citrus* and *Murraya Kœnigi*. Within the genus *Murraya* itself we have a similar progression from *M. exotica* to *M. Kœnigi*. A study of further genera of the Aurantieæ may prove to be interesting.

Grateful acknowledgment is made to Dr. M. A. Sampathkumaran for guidance throughout the course of this work.

R. S. CHAKRAVARTHY.

Central College,
Bangalore,
September 5, 1936.

[1] Schnarf, *Embryologie der Angiospermen*, 1929.

[2] Chakravarthy, R. S., *Curr. Sci.*, 1935, **3**, No. 8, 361-362.

Teratological Notes.

ABNORMALITIES have been recorded in the following plants :—

A. *Solanum Melongena* Linn. (*Solanaceæ*).
B. *Phlox Drummondii* (*Polemoniaceæ*).
C. *Jasminum humile* Linn. (*Oleaceæ*).
D. *Bauhinia variegata* Linn. (*Leguminosæ*).

A. The plant of *Solanum Melongena* (Fig. 1) under consideration is very striking because of the following abnormalities :

Fig. 1.

1. Plant is devoid of prickles. This fact is not strange, as in rich soil prickles often disappear.

2. Lower and upper leaves are quite abnormal, more or less lanceolate. Leaves in the middle region are normal, but devoid of prickles.

3. (*a*) Flowers are quite abnormal ; axillary, green. Sepals very much enlarged, pale-green. In the region of the corolla, there is only one leaf of the same size and shape as the sepals, somewhat like a spathe half-enclosing a small bunch of minute leaves on which still smaller leaves are attached. There is no ovary, only a disc-like structure is present above the pedicel.

(*b*) Calyx of 5 sepals, 3 small and 2 big, of the same shape as those in (*a*) but the biggest ones are half the size of those in (*a*). In the region of the petals are two green leaves, lanceolate in shape. Below the sepals is a cup-shaped 3-lobed structure. Ovary is raised on a stalk, resembling a gynophore or

a developing fruit of *Capsicum*; no style, stigmas 2 (Fig. 2).

4. On examining the cross-section of the ovary (Fig. 3) it is found that there are 2 loculi and the placenta is axile, but there are no

Fig. 2.

Fig. 3.

ovules, they are only represented by tooth-like structures projecting from the placenta. The remaining portion of the ovary is hollow.

DISCUSSION.—This is a fine case of reversion to the primitive type.

The flowers are stalked, hence no degeneration has taken place in this respect. The lowermost or first whorl of leaves in the flower may be taken as sepals, the second whorl of green leaves in the region of the corolla are petals which have reversed to the leafy form. So have the stamens. The absence of style also shows a reversion to the primitive type in which the stigma was without a stalk.

An example of this type is very interesting from the point of view of illustrating the evolutionary progression of the flower, and also serves as a good example of phyllody (Chloranthy).

B. *Phlox Drummondii*.—Four styles were observed in a few flowers of *Phlox Drummondii* growing in the Botanic Garden, Osmania University. As a rule there are only three styles in *Polemoniaceæ*.

C. *Jasminum humile* Linn.—Three stamens have been observed in some flowers of *J. humile* growing in the Botanic Garden of the Osmania University. The majority of the *Oleaceæ*, as is well known, possess only two stamens of the ancestral tetrandous flower. The specimens under consideration show a partial reversion to the original type.

D. *Bauhinia variegata* Linn.—Only one fertile stamen is found. As a rule there are three to five fertile stamens. Cooke mentions that one fertile stamen is found in *Bauhinia monandra* which is mistaken for *Bauhinia variegata*.

M. SAYEEDUDDIN.
M. A. SALAM.

Botany Department,
Osmania University,
Hyderabad (Deccan),
September, 1936.

Cooke, T., *The Flora of the Bombay Presidency*, Part III.

Hooker, J. D., *F.B.I.*, V, III and IV.

Worseell, *The Principles of Plant Teratology*.

A New Species of Myxosporidian from the Heart of a Marine Fish, *Otolithus ruber*.

A HITHERTO unrecorded species of *Henneguya* has been found as a tissue-parasite in the bulbus arteriosus of *Otolithus ruber*. Kudo[1] records 32 species of *Henneguya* of which all except *H. neapolitana*, are from fresh-water fishes. The only previous record of a Myxosporidian infecting the heart was made by Keysselitz[2] of *Myxobolus cordis*, from the ventricle of *Barbus fluviatilis*.

Of the fish examined in this Laboratory, almost seventy-five per cent. show infection in different degrees. When the infection is fairly heavy, the affected area presents numerous white pustules, which are really the cysts of the parasite containing the spores. Vegetative forms, propagative stages, and spores have been observed. The phenomenon of diffuse infiltration seems to be much pronounced in this parasite, bringing about considerable pathological changes. The development, infection, histopathology, and allied problems connected with this parasite are being studied in detail.

P. N. GANAPATHI.

University Zoological
Research Laboratory,
Madras,
October 5, 1936.

[1] Kudo, R., *Illinois Biological Monographs*, **1919, 5**, 1-265.

[2] Keysselitz, G., *Verh. Ges. deutsch. Natur. u. Arzte, Vers.*, **1908, 79**, 452-453.

The Dorsal Spine of the Lac Insect and Its Function.

In 1863 von Gernet[1] illustrated (his Fig. 4*b*) a lac insect with two spinoid tubercles which Comstock[2] attributed to an error of observation. However, a somewhat confirmatory observation was made by me[3] in 1923. With these two exceptions Gernet's observation has passed into oblivion.

Since I was able to confirm the rest of Gernet's findings without exception, I came to the conclusion that such a conscientious worker must have actually seen the specimen he illustrated with two spines. I subsequently started to investigate in order, if possible, to vindicate von Gernet. Every morning a handful of lac encrustation was dissolved in alkali solution, and the insects were observed under a microscope for the presence of two spines. An exhaustive examination of material collected from different sources in India proved in vain. The investigation was then extended to include stick lac imported from Tonkin, Indo-China. From stick lac borne by a *Dipterocarpus* tree I got a specimen, *Lakshadia chinensis* whose spinoid tubercle is illustrated in Fig. 1. The slide bearing the object is now deposited in the American National Museum, where my collection of parasites had been previously deposited, and its receipt has been kindly acknowledged by Dr. H. Morrison in his letter, dated 7th July 1936.

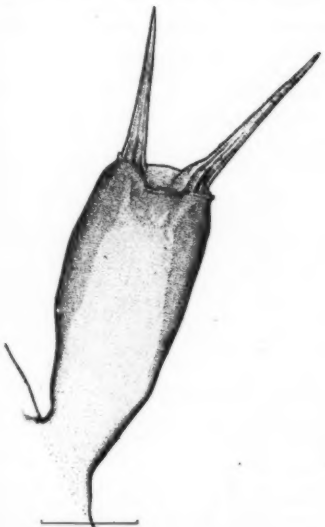


Fig. 1.

A spinoid tubercle bearing two spines; *Lakshadia chinensis* on a *Dipterocarpus* tree from Tonkin; Monsoon crop.

Fig. 2.

A normal spinoid tubercle of *Lakshadia chinensis* on *Cajanus indicus* from Assam; Monsoon crop.

In order to compare the abnormal spinoid tubercle, I have added Fig. 2 which also refers to a *Lakshaida chinensis* insect from Assam, where it was growing on *Cajanus indicus*. The figure shows the thick chitinisation from the terminal spine downwards till the basal portion is like the ordinary skin. A. B. Misra[4] has much simplified his task by showing as though when the chitinisation can be divided into two main parts the spinoid tubercle belongs to a new species (his Fig. 1*d*); and when the chitinisation can be divided into three regions (his Fig. 2*d*) the spinoid tubercle belongs to a still another species. I maintain that these two species of Misra are identical with mine so that his figures and Fig. 2 given here all show the normal but polymorphic spinoid tubercle; while Fig. 1 represents an abnormality so rare that it taxed all my patience to find a single example possessing such a type.

The function of the spinoid tubercle has been considered a puzzle by most authorities. There has appeared only one explanation as to its function[3] and A. B. Misra[5] has refused to be enlightened by it. A typical scale insect grows flat on the twig; on the contrary the lac insect grows vertical to its main axis, a fact also observed by von Gernet. As the secretion of lac grows more copious the cell-wall grows from the ventral side towards the dorsal surface. As the dome-shaped cell of the lac insect enlarges the cell-wall increases in length, the direction being from the ventral towards the dorsal side. If the dorsum of the insect were quite free, the body would finally lie in a pit, while its secretion would be raised like a cylinder around it. But the dorsal skin of the insect is attached to the ceiling of the dome-shaped cell by means of the spinoid tubercle so that, as the cell-wall and the ceiling are gradually raised higher, the skin, attached to the ceiling, is also stretched and the body as a consequence grows vertically. The dorsal spine thus acts like a nail attaching the dorsal skin to the cell dome growing faster; the body of the insect gradually fits into a growing mould as it were, the mould being the secretion of the insect itself.

It naturally follows that should one nail not suffice a second would have to be developed to anchor the skin. An insect with two spinoid tubercles or one tubercle with two spines would thus confirm the above explanation as to the function of the dorsal spine among lac insects.

S. MAHDIHASSAN.

C/o The American Express Co.,
Berlin,
August 31, 1936.

[1] *Bull. Soc. Imp. Nat. Moscou*, 1863, **36**, Pt. 2.
[2] *Report on Scale Insects*, 1882.
[3] *J. Sci. Assoc. Maharaja's Coll., Vizianagaram*, 1923, **1**.
[4] *Bull. Ent. Res.*, 1930, **31**, Pt. 2.
[5] *Proc. Zool. Soc. London*, 1931, p. 315.

Tadpoles of *Rana tigrina* Feeding on Mosquito Larvae.

DURING rains mosquitoes lay their eggs in waters accumulating in holes, cavities and shallow depressions. But the larvæ, however, are found abundantly in accumulated waters within the inhabited localities and strange though it may seem, they are almost absent from the accumulated water-stretches beyond the limits of human habitations with surroundings of bushes and plants. Repeated observations have elucidated the fact that tadpoles of *Rana tigrina*, with which these shallow pools or water-stretches are infested, voraciously swallow these larvæ. The tadpoles of *R. tigrina* also relish the tadpoles of *Bufo melanostictus* Schneid. Not a single tadpole of the latter species is found in localities where those of the former are abundant. Unlike the common tadpoles of *B. melanostictus*, those of *R. tigrina* lie quietly at the bottom like mud-fish, and whenever any mosquito larva moves meanderingly to get to the surface of water they swoop at it from a distance and swallow it at once.

For verification, tadpoles of *R. tigrina* were reared in experimental tanks and it was observed that they voraciously feed on mosquito larvæ and tadpoles of *B. melanostictus*.

G. C. BHATTACHARYA.

Bose Research Institute,
Calcutta,
May 22, 1936.

The Supposed Sanskrit Seal from Rohtak: A Correction.

I AM indebted to Dr. A. S. Altekar of Benares, who examined my "Bhadramitra" sealing from Rohtak on September 6, for certain important comments on Mr. Jayaswal's reading[1] which I had reproduced in a recent note.[2] As Dr. Altekar rightly said, the first letter in the second line is a simple स *sa*, not a स्य *sya*. The seal, therefore, is not in pure Sanskrit as Mr. Jayaswal thought. A similar combination of the Sanskrit form त्र *tra* with the Prākrit स *sa* (instead of the Sanskrit generative स्य *sya*), has been met with in several coins of the Śuṅga period: *Agnimitrasa*, *Bhānumitrasa*, *Bhūmimitrasa*, etc.[3] Dr. Altekar also says, with much justification, that the last two letters, read by Mr. Jayaswal as घाटे, are by no means clear in the original. These and other criticisms were also made soon afterwards by Rai Bahadur Pandit Prayag Dayal of Lucknow, Rai Bahadur Daya Ram Sahni, now Director of Archæology in Jaipur, and Mr. K. N. Dikshit of the Archæological

(*Continued on page 215.*)

SUPPLEMENT TO "CURRENT SCIENCE".

Vol. V] October 1936 [No. 4

Vitamin B_1 (Oryzanin, Torulin, Aneurin).

Its Chemistry and Mode of Action.[a]

By Rudolph A. Peters, *Oxford.*

NO review on this subject would be complete without a passing allusion to the work of the pioneers. Without Eijkmann and Grijns[1] and the workers in the Phillipine Islands, such as Braddon, Fraser and Stanton, Chamberlain and Vedder,[1b] scientific work upon beri-beri could not have started. In India too, the researches of Sir Robert McCarrison are too well known to need further comment.

'Vitamin B' was differentiated as one of three necessary vitamins by McCollum and Davis,[1] the other two being fat soluble A and vitamin C. Only the latter had retained its single blessedness. Vitamin B has become more subdivided as the result of research even than the original fat soluble vitamin A.

Vitamin B_1 is the original antineuritic vitamin which is curative to beri-beri and has been termed torulin, and oryzanin and aneurin.[2] The term antineuritic should be discarded now, as it lays too much emphasis upon the relation to the nervous system, and too little upon the general need among cells for this factor. It disregards the fact that the deficiency of the A vitamin also has effects in the central nervous system.[3] The pure chemistry of vitamin B_1 has advanced much of late. The work of the pioneers among whom we may mention Hopkins, Funk, Hofmeister, Williams and Seidell[4] has finally led to the preparation of the vitamin in a pure state. Crystals of high activity were first obtained in Java in 1926 by Jansen and Donath. More recently the pure vitamin has been prepared in several laboratories at about the same time, namely, Van Veen[5] in Java, Ohdake[5] in Suzuki's laboratory in Japan, Windaus[6] and colleagues in Germany, Kinnersley, O'Brien and Peters[5] at Oxford in England, and Williams and colleagues in America.[5] The steps which have proved important in the isolation, may be briefly mentioned; the finding that the vitamin was precipitated by basic precipitants, such as silver nitrate and baryta, and phosphotungstic acid; that it was adsorbed from very impure and dilute solutions with fuller's earth, from which it could be eluted by baryta, or quinine; that it was adsorbed by charcoal from which it could be removed by acid alcohol; that the precipitation with phosphotungstic acid could be made selective by varying the pH of the solution; and that crystallisation is interfered with by traces of salts. To this must be added the considerable information which gradually accumulated upon the conditions of stability of this factor. It is for instance destroyed at 120° C. by the autoclave and more readily by heat in alkaline solution but not at lower temperatures to the same extent. It is not destroyed by nitrous acid,[11] though this has been disputed. It is eluted from most natural sources by slightly acid 50% alcohol. The sulphates and nitrates of vitamin B_1 are known, but the form isolated is usually the hydrochloride as colourless plates or needles, soluble in lower strengths of alcohol, but rather insoluble in absolute alcohol. It is believed to be the vitamin for several reasons; we may mention the constancy of composition and identity of biological and of spectroscopic behaviour of different preparations made from rice and yeast in

[a] There is no attempt to make this review comprehensive in detail, but to indicate the present position of research.

[b] The book of Vedder on beri-beri must always be a classic.

different laboratories by rather different methods. It is now known to contain S[6] and has the composition $(C_{12}H_{17}ON_4S.HCl)Cl$. The precipitation properties recall those of histidine. Usual methods of degradation with the small amounts of substance available, amounting perhaps to not much more than 10 gm. in the hands of any one individual, proved of little avail,[c] until Williams[7] and his colleagues[d] brilliantly chose the unusual reagent sulphite; under the action of this the vitamin splits smoothly to a pyrimidine and a sulphur containing substance 4-methyl 5′β-hydroxyethyl thiazole which can be oxidised to 4-methyl thiazole 5 carboxylic acid.[8] This has been established now by synthesis in an excellent work by Clarke and Gurin.[9] Let us now see how some of the facts about the vitamin fit with this knowledge. Some general properties are summarised in Table I.

Let us first consider the behaviour upon titration. The vitamin titrates to give a normal weak basic group at pH 4·8, but upon making more alkaline than pH 7·0, there is a tendency for the pH to swing back to the acid side after each addition of alkali; until two equivalents are reached, the vitamin cannot be titrated permanently over to the extreme alkaline side. This is believed to be due to a quaternary N atom of unusually weak basicity. Synthetic methyl thiazoles behave in a similar way provided that they are substituted in the 4 position, and that they are treated with methyl iodide to convert to the quaternary form. These facts are summarised in Table II. It is seen that several properties

TABLE I.[10]

Properties of vitamin B_1.

	References	pH 1–4	4–7	7–9	9–11
Colour ..	(1) (2)	Colourless	Colourless	Yellow fading to colourless (R)	
Spectrum ..	(3) (4) (5) (9) (10)	247 *mμ*	234 *mμ* and 268 *mμ*	Increase in absorption at 233 *mμ* and appearance of broad band at 330-340 *mμ* rapidly fading	
Titration ..	(6) (7) (11)	..	Basic group pK 4·8	Pseudo-acid group at pH 9·0 appears slowly with pK 6·5 [R] and requires 2 equivalents of alkali	
Capacity for giving azo colour reaction	(8)	Stable	Stable	Tending to become unstable and much lost in performing alkaline titration (I)	
—SH. reaction ..	(1)	..	..	No	Present only after warming with strong alkali
Activity ..	(2)	Normal	Normal	Normal	Lost gradually on heating (1).

R = Reversible. I = Irreversible.

(1) Van Veen, 1933; (2) Kinnersley *et al.*, 1935; (3) Peters and Philpot, 1933; (4) Smakula, 1935; (5) Holiday 1935; (6) Birch and Harris, 1935; (7) Moggridge and Ogston, 1935; (8) Kinnersley and Peters, 1934; (9) Winterstein *et al.*, 1935; (10) Heyroth; (11) Ogston and Peters.

TABLE II.

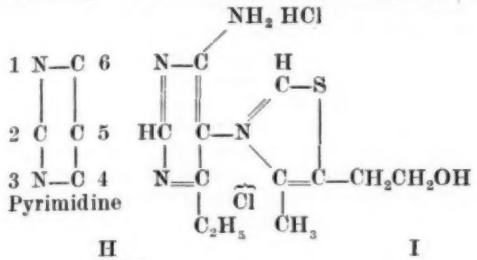
Behaviour of synthetic methyl thiazoles.

	N	Spectrum Band[12]	pK basic[13]
4-Methyl thiazole hydrochloride	Tertiary	251 *μμ*	3·6
2·4-di-Methyl thiazole HCl	Tertiary	254 *μμ*	—
4-Methyl thiazole ethiodide	Quaternary	225 *μμ*	9·5 behaving as B_1

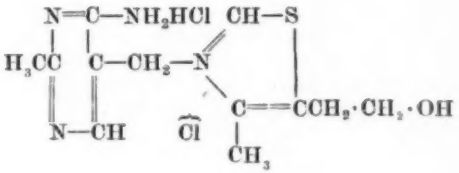
[c] In Oxford we worked up 4½ tons of yeast to obtain about 3·0 gm. Our present best yield from enriched yeast is 100 mg. per cwt.

[d] It is interesting to note that the use of this unusual chemical reagent was due really to the previous biological work; much vitamin had once been lost in an attempt to preserve with sulphite.

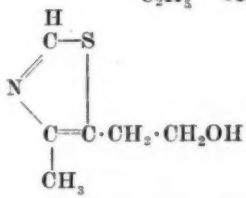
of the vitamin as regards the spectrum and titration curves agree with this value. It is not clear however why the vitamin in neutral solution gives the band at 268$\mu\mu$ as well as that for the quaternary thiazole. The two equivalents of alkali required are somewhat of a puzzle; some think that the thiazole group opens with action of alkali. Against this is the finding that there is no nitroprusside reaction (for —SH) until after warming. The vitamin very easily gives



I



II



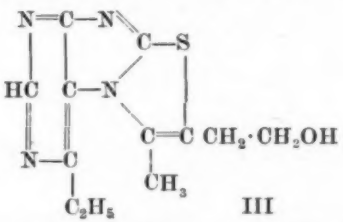
4-methyl 5′β-hydroxyethyl thiazole

off H_2S on warming with alkali without degradation of N to NH_3. The composition of the other fragment is believed to have the pyrimidine nucleus but it is not so clear. It is rather interesting to realise that there has been the feeling from the start of vitamin chemistry, that the compound might be allied to the nucleotides. Williams and colleagues[13] from their own experience originally thought that they were dealing with the 5-amino 4-ethyl pyrimidine; they thought themselves in consonance with Windaus *et al.* Upon the basis of this they originally proposed formula I.

This formula has now been synthesised by Bergel and Todd,[14] who find that it has no vitamin activity. At the same time Williams *et al.*[13a] state that they have abandoned the original view and that they incline to formula II, which was actually first proposed by two Japanese on theoretical grounds.[15]

Part of their evidence is that they have obtained from the vitamin with liquid ammonia a free base $C_6H_{10}N_4$ which agrees in spectra best with 5-alkyl 6-amino pyrimidine. It seems that we shall have to await synthesis before we feel confidence in the present proposal. It must be edtadmit that the reaction producing thiazole is a curious one, and that from an analogy with uric acid, the degradation products may prove to follow rather unusual lines. Not much modification of the structure is required to approximate to adenyl thio methyl pentose isolated long ago by Suzuki[16] and colleagues.

A compound that is playing some part in the assessment of structure is thiochrome,[17][e] which is a quinochrome or blue fluorescent compound. The oxidation of mere traces of vitman B_1, even at biological C_H under certain conditions, produces a brilliantly fluorescent compound (ultra-violet light), which is in appearance much like lumichrome a degradation product of the flavin component of vitamin B_2. The latest suggestions attribute to this the formula III.



III

The synthetic I does not give the same fluorescent product upon oxidation as the vitamin. There are some features of thiochrome unexplained by formula III. It still gives the quaternary shift in the titration[18]

[e] Found and identified in yeast extracts.

though there is a change in the state of the S.[f]

The azo reaction, behaviour to diazotised sulphanilic acid, deserves especial mention.[19] At the ordinary alkalinity of the Pauly reaction there is hardly any colouration; but in a rather more alkaline medium, there is a marked formation of a pink colour, which comes to maximum in 30 mins. and then fades. In presence of formaldehyde the colour is more stable, and standards can be made up for vitamin estimation, which last for several weeks. At first it was thought that the reaction must be due to the NH_2 group at position 6, but it seems to be given by the thiazole part of the molecule.[20] The reaction is useful for fairly pure vitamin but not available at present for dilute impure solutions. It is not yet certain to what part of the molecule the special properties of the vitamin as catalyst are due (*cf.* 11).

Now that the constitution of the vitamin seems to be advancing towards a settlement, we are in a position to ask the next question, what is the exact function of the vitamin in the body? Does it merely act as some integral part of a surface membrane, or is it an essential catalyst? If the latter, what reaction does it catalyse?

THEORY OF ACTION.

There have been in the past two main views as to the function of the vitamin, (1) that it was concerned with carbohydrate metabolism[21] and (2) that it was related to tissue oxidations.[22] These views were early propounded, and have given rise to much work, some of it unfortunately not sufficiently controlled to permit of the conclusions drawn.[50] For instance many things will disturb carbohydrate metabolism indirectly, a high blood sugar or lactic acid content may merely mean that an animal has been given exercise or is suffering from anoxæmia. Related to this question has also been the vexed difficulty of inanition. Fortunately recent work in the Biochemical Laboratory at Oxford[g] has gone some way to clarify the position, and has indicated that there was truth in each of these earlier views. At first we supported the lactate oxidase theory but have abandoned this. Our latest theory, which has much experimental support, is that vitamin B_1 is concerned in the oxidation of pyruvic acid (an essential stage in the intermediary metabolism of the carbohydrates). Let us consider the proof of this. The following experiment shows the main points in question. A pigeon is fed to the stage of convulsions with polished rice. Parts of the brain,[23] the cerebral hemispheres and the optic lobes, were taken out of the animal and minced under careful conditions; they were then placed into the bottles of a suitable micro respirometer (Barcroft or Warburg type) in Ringer bicarbonate or Ringer phosphate solutions. The latter is better for this purpose. The amount of solution usually used is 3·0 c.c. and it may contain either lactic acid or pyruvic acid as substrates. At pH 7·3 (the pH of the blood approx.), the respiration of avitaminous brain rapidly falls off as the tissue is allowed to respire at 38° C. If however as little as 2γ of vitamin is added, the respiration of the samples is much altered. That with vitamin will increase largely as compared with the control. There is here therefore

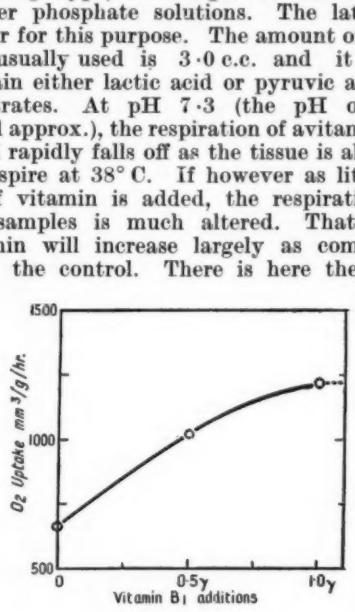
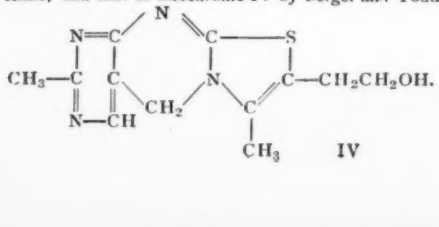


Fig. 1.

an *in vitro* action of vitamin B_1. The effect can be observed with amounts of $0·2\gamma$ or even less; and as the amount of oxygen taken up is much greater than the amount of vitamin added, it is clear that we are dealing

[f] Since writing the above, the synthesis of vitamin B_1 as formula II has been accomplished by Williams and Kline, and that of thiochrome IV by Bergel and Todd.



IV

[g] The writer's colleagues in this work have been H. W. Kinnersley, R. B. Fisher, N. Gavrilescu, A. P. Meiklejohn, R. Passmore, H. W. Sinclair, R. S. Thompson, R. E. Johnson, H. Rydin, J. R. O'Brien, G. K. McGowan.

with a catalytic action. The effect is hardly noticeable with the normal brain, and it disappears progressively with the degree of cure of the animal, even when no food has been given. This settles definitely that there is a deficiency of vitamin B_1 in some part of the brain which is a specific and not a general deficiency (it is not due to general inanition[4]). The deficiency shows itself as a change in the oxidative capacity of the tissue (respiration if we prefer the term), and further it may be added that (with the exception of glucose it is not shown with other substrates used among which we may mention especially succinate. It is a defect of a peculiar type in the intermediary metabolism of the carbohydrates. Of course it cannot be said that the brain in the bottles is behaving like normal brain *in situ*, but there is enough evidence to show that it is not an entirely artificial story. Among the peculiar facts discovered about these respiring enzyme systems was one which excited considerable interest, namely, the finding that pyruvate was present in the bottles after avitaminous brain had respired *in vitro* in lactate solutions. The presence of vitamin reduced almost to normal these abnormal amounts of pyruvate. They are not found with normal brain unless there is also a poison in solution (such as iodoacetate or arsenite). It might be argued in this latter case that they appear owing to the abnormal effect of the poison, but their presence in the avitaminous system seems very strong evidence that pyruvate is really a stage in the normal oxidation of lactate. The story does not however stop here, because it has been noticed that in the blood of the polyneuritic pigeon and rat there is an abnormal accumulation of pyruvate as well as of lactate, which had been previously known. The same state of the brain can also be noticed in the rat, though it is much less marked, and the blood is also found to have a raised pyruvic acid. Quite recently there has come to hand from China (Platt and Lu)[24] the interesting information that in beri-beri too this happens. It is indeed possible that the presence of abnormal pyruvic acid in the blood may be found to be a clinical test of some importance for the beri-beri condition. There has not been found abnormal pyruvic acid in any other clinical condition at the present time.[25] Here, we have a beautiful example of the importance of carrying out investigation for its own sake. From experiments carried out upon dead tissue with the academic object of advancing the study of an enzyme system has come something which may prove to be of real clinical value. It is of the greatest theoretical interest that there should be such definite evidence for the presence of pyruvic acid as a normal intermediary metabolite. Prominence has been given to this by the Embden Meyerhof[26] scheme of carbohydrate degradation, the evidence for which has so far been culled from tissue brei poisoned with iodoacetic acid. The conclusions reached have been recently embodied in the accompanying provisional scheme (Fig. 2).

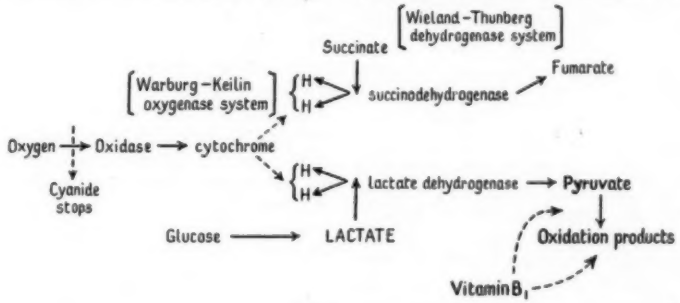


Fig. 2.

Hydrogen is mobilised by the specific dehydrogenase systems and transferred to the activated oxygen to form H_2O_2. Scheme adopted from Keilin with additions from Green and Ogston.

Further facts have been ascertained about the behaviour of these enzyme systems which are still rather obscure. Among these we may mention the curious action of pyrophosphate in helping the maintenance of respiration when the substrate is lactate. The fate of the pyruvic acid is still a mystery. In unpublished experiments with G. K. McGowan

[4] The inanition is secondary.

it seems certain that it is not all burnt, but no support has been obtained for the common conception that it is oxidised *via* succinic acid. Unlike the suggestions which arise from muscle (Embden Meyerhof) the pyruvic acid in these brain systems has not been found by Johnson to interact with α glycerophosphate. The poisons iodoacetic acid and fluoride both inhibit the vitamin effect, but only in the presence of the former does pyruvate accumulate from lactate. Arsenite also stops the vitamin action in small traces and leads again to pyruvate accumulation.[27]

It is believed that this biochemical lesion is noticeable first in the lower parts of the brain and that as the vitamin B_1 deficiency increases it spreads to other parts also. In harmony with this view Rydin[23] found that in the bird which did not show the true symptoms so well known to be characteristic of polyneuritis, there tended to be a deficiency in the cerebrum without one elsewhere.

It is clear that whatever may be the state of the nerves in human beri-beri, in the case of the animal the well-known acute symptoms of vitamin B_1 deficiency are associated directly with the loss of vitamin B_1 from the central nervous system. Later as the result of this loss, further changes may set in elsewhere which cannot then be readily cleared up, as is the common experience in dosing one of the chronic cases with vitamin B_1.

These recent results embodied in the pyruvic acid oxidase theory appear to decide an essential function of this vitamin, *viz.*, that it catalyses a tissue reaction; it is not yet certain that it is the only one. Grosser changes occur in animals and man as the result of deficiency, accumulations of lactate and œdema, and in the terminal stages alterations in carbohydrate tolerance and brady cardia.[28] The lactate accumulations may be explained on the pyruvic acid theory, but it is possible that they are also indirect in another sense due to some such action as excessive adrenalin. Behaviour to insulin is normal.[29] The writer believes that the biochemical lesion in the lower part of the brain induces these secondary disturbances in carbohydrate regulation in the body (*via* hypothalamus and associated centres). This regulation has been shown in recent years to depend upon the control of this part of the brain.[30] Such brain disturbance might again account for failures in temperature regulation as well as the reported excessive storage of glycogen (Abderhalden and Wertheimer)[31] in the liver. In other words, the direct biochemical lesion induces secondary chemico-physiological changes in the inter-tissue transfer of carbohydrates. Oedema appearance is not yet explained, though the kidney in birds also suffers from faults due to lack of vitamin B_1; nor again can we yet properly explain the failure in appetite, that early and most constant symptom of deficiency of this vitamin, which has been much investigated by Cowgill and colleagues[32] especially in dogs. It is this which leads to the accompanying inanition. The failure of appetite (anorexia) is a feature of great importance in practical nutrition and should be treated with concentrated vitamin B_1 preparations.

METHYL GLYOXAL.

Geiger and Rosenberg[33] have described the presence of methyl glyoxal ($CH_3.CO.CHO$) in urine of infants suffering from vitamin B_1 deficiency. This is of theoretical as well as practical interest. The methyl glyoxal theory of carbohydrate degradation has been given up lately, though there are observations by Gaddie and Stewart[34] which suggest that it may still be needed. This abnormal methyl glyoxal may prove to be due to the lack of glutathione. Glutathione is well known to be a co-enzyme to glyoxalase which has for long been considered to be deficient in beri-beri animals (Findlay).[1] There have been several papers describing change in the —SH compounds in this condition,[35] but this matter is not definite. The claims of Randoin and Fabre have been vigorously disputed by Mattei. Methyl glyoxal is entirely absent from the brains of avitaminous pigeons.[35a]

ADENINE.

The relation of adenine to part of the proposed structure of vitamin B_1 is suggestive. Vitamin B_4 (Reader[36]) consists largely of adenine, and Guha[37] has suggested that irradiated adenine has action in relation to these compounds. His first idea that it would function as vitamin B_1, he has now abandoned. It is the writer's belief that some unknown relation exists. Dr. Holiday supplied him with a specimen of irradiated adenine upon one occasion which had a weakly curative effect upon pigeons. Lately Birch and Mapson[38] have stated that the heart of the vitamin B deficient rat is more

susceptible to the action of adenylic acid, and that there is less de-aminase.

TESTS FOR VITAMIN B_1 AND STANDARDISATION.

Vitamin B_1 is at present standardised against a particular sample of acid clay supplied by Jansen from Java, 10 mg. of this equals 1 International Unit. It seems agreed that 1 I.U. is approximately 2γ vitamin B_1 Cl. HCl, though some quote the figure a little higher, up to $3 \cdot 3\gamma$.[39]

The tests available are as follows: (1) a colour reaction formaldehyde-azo test for pure forms of vitamin, (2) the so-called catatorulin test,[39] making use of the brain enzymes from the avitaminous pigeon; (3) the brady cardia test, in which the slowing of heart in rats is used as a test; (4) growth tests in rats; (5) maintenance tests in pigeons; (6) protective tests in the tropical rice-bird *Munia Maja*; (7) curative tests to the pigeon in ophisthotonus.[i]

AMOUNTS OF VITAMIN B_1 REQUIRED.

According to recent estimates, man requires 250–500 units of vitamin B_1 daily, *i.e.*, about 1·0 mg. vitamin B_1 for health. The amount varies with the rate of metabolism and therefore with the weight. For clinical trials Vorhaus, Williams and Waterman[40] consider it essential to give doses up to 10 mg. of crystalline vitamin B_1. These authors have evidence that it is of value in various neuritic conditions and they are supported by others such as Ritchie Russell[41] and Strauss[42] in alcoholic polyneuritus. From clinical impressions of beri-beri, we should look for its use preferably by injection, in loss of appetite, œdema, palpitations and breathlessness, and painful muscles.[43]

There is a rather wide difference between the amount of vitamin B_1 required to produce a temporary cure in a pigeon (about 10γ for 5 days) and that needed for the maintenance of health at maximum possible weight, at least 20γ per diem.[44] There is evidently much more work to be done to clarify the position. The rat (weight 400 gm.) needs about 5γ per diem.

[i] For Schopfer's test, see below.

VITAMIN B_1 VALUES OF FOODSTUFFS.

A recent determination of vitamin B_1 values has not substantially altered previous conceptions. The subject has been well reviewed by Aykroyd.[45] It is important to remember that the vitamin B_1 content of foods such as milk or yeast may be variable. The richest sources are vitamin enriched yeast and wheat germ. Then come liver, pork, beans and egg yolk. Recent estimations have been made by Baker and Wright.[49]

VITAMIN B_1 IN URINE AND BLOOD.

Urine.—It has been known for some time that vitamin B_1 was present in urine and could be adsorbed upon charcoal. Recently, studies with the evaporated dry solids of urine, with an acid clay adsorption product from urine and with the urine itself agree in the conclusion that avitaminous urine from rats contains very little B_1; on the other hand that from animals upon a normal diet contains this vitamin.[46] Further it seems that giving a dose of vitamin B_1 to a human will increase excretion but not to the full extent of the dose, supposing the person to be saturated. There is evidently more to be explained. The average excretion of healthy adults was of the order of 12–35 I.U. whereas the daily diet must contain about 300 units for health.

Blood.—Studies upon blood have been delayed by the want of a sufficiently sensitive test. The micro-organism test of Reader with Streptothrix corallinous was valuable but not quite specific. Recently Schopfer[47] has found that a mould (Phycomyces Blakesleeanus) can be grown upon media so that minute amounts of vitamin B_1 will act as an essential growth factor. Within limits of $0 \cdot 1$–$1 \cdot 0\gamma$ per 10 c.c. of medium, the weight of mycelium is proportional to the amount of vitamin B_1 added. Under special conditions worked out by A. P. Meiklejohn,[48] the B_1 content of blood can be estimated; the values reached are for pigeons normal 27γ per 100 c.c. blood avitaminous, $5 \cdot 5\gamma$ per 100 c.c., and for some normal humans 8–10γ per 100 c.c.; *i.e.*, in the human where B_1 deficiency shows less readily, there is an average lower concentration of vitamin B_1 than in the pigeon. Tests upon patients are hoped to give

concrete evidence as to the degree of avitaminosis.

In reviewing the many-sided problems still presented by this important growth factor, it is felt that the future years cannot fail to reveal other interesting aspects of its action. Though not the first vitamin to be isolated or prepared synthetically, it may fairly be claimed that it is the first case in which vitamin deficiency symptoms have been correlated with a biochemical reaction, as well as being the first instance of a thiazole ring in nature.

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[10] Table I, (1), (2), (3), (4), (5), (6), (7), (8), (9), see [11], (10) Heyroth, *Biochem. J.*, 1936, **30**, (11); Ogston and Peters, *Biochem. J.*, 1936, 30.

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[18] See (10), (11).

[19] Kinnersley and Peters, 1934, see (11).

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[50] See especially Westenbrink, *Arch. néerl. Physiol.*, 1932, **17**, 239.

Survey of India, to all of whom I am likewise indebted. As the original sealing will now no doubt be subjected to a critical examination by expert epigraphists, who may raise further points about the reading and interpretation of the sealing, I should content myslef on this occasion with publishing only the main criticisms, about which I also feel convinced. I confess that when, after receiving Mr. Jayaswal's reading, I tried to confirm it with the help of Bühler's palæographic chart and Ojha's monograph, I failed to get satisfaction over the supposed स *sya*; but as a novice in this line I could scarcely question the authority of so able a scholar as Mr. Jayaswal, to whom I owe my own introduction to the Brāhmi script.

B. SAHNI.

Lucknow,
October 2, 1936.

[1] Jayaswal, *Journ. B. and O. Research Society*, June 1936, **22**, Part 2, p. 62, pl. IV, fig. 18.

[2] Sahni, *Curr. Sci.*, August 1936, p. 80.

[3] *Cat. of Coins in the Ind. Museum*, **1**, 186–189.

Thickness of Bran Layers in Rice.

IN a note about the nutritive value of parboiled rice[1] Sreenivasan and Das Gupta have drawn attention to the fact that coloured varieties of rice (and coarse varieties in general) have thicker bran layers and contain very much more of nitrogen and phosphorus than the superior white varieties. This fact had been noticed at Coimbatore earlier when a number of rice varieties was studied histologically. I am glad that the Coimbatore findings are being confirmed by the authors. Since the results obtained at Coimbatore were originally published in the annual station report which is not usually available to the public, they are reproduced here.

The bran layer which contains the nutritive principles in rice and which usually gets removed with polishing, consists of the pericarp and some aleurone layers. The thickness of the bran layer is found to be not uniform all round the grain. It is somewhat thicker on the dorsal side of the grain (towards the palea) than on the ventral side. The table below gives the thickness of the layer on the two sides for 23 varieties of rice whose grain sections were examined under the microscope. The table also gives information about the colour of the bran layer in the rices examined and their classification into coarse, medium or fine. While it is evident that the coloured rices do generally contain a thicker bran layer some of the white rices also are found to possess this characteristic.

Variety	Grain size (coarse, fine, etc.)	Thickness of bran layer in microns (Pericarp + Aleurone)		Rice colour
		Dorsal side	Ventral side	
Black Puttu	Coarse	62·3	40·5	Purple
T. 303	do	53·3	37·4	White
T. 326	do	54·1	32·8	do
T. 88	do	48·8	32·1	Gr. Brown
T. 219	do	50·1	30·6	White
Co. 4	do	48·1	28·5	do
T. 29	do	52·8	39·3	Red
T. 248	do	44·1	38·3	do
T. 375	do	41·0	31·3	do
T. 73	Medium	54·8	33·8	do
T. 132	do	56·6	39·1	Brown
Co. 6	do	43·8	28·8	White
Co. 5	do	44·5	30·3	do
Co. 7	do	41·8	31·6	do
Co. 2	do	47·8	28·8	do
T. 218 (Adt. 4)	do	36·8	21·3	do
T. 217 (Adt. 3)	do	36·0	22·0	do
Co. 3	do	34·3	22·0	do
Co. 1	Medium Fine	42·3	25·8	do
T. 2	Fine	42·6	25·6	do
T. 124	do	47·1	27·3	do
T. 109	do	37·8	24·8	do
GEB. 24	do	35·3	26·1	do

[1] *Curr. Sci.*, 1936, **5**, 75.

K. RAMIAH.

Agricultural Department,
Coimbatore,
August 29, 1936.

REVIEWS.

Insulin—Its Production, Purification and Physiological Action. By Douglas W. Hill and Federick O. Howitt. (Hutchinson's Scientific and Technical Publications.) 1936. Pp. xi + 219. 12*s.* 6*d.* net.

"The discovery of insulin," as Prof. E. C. Dodds rightly observes in a foreword to this book, "can be described as one of the most important and dramatic events of the present century." The classical experiments of von Mering and Minkowski connecting the pancreas with the normal maintenance of the blood-sugar level had their culmination, after many failures, in the successful preparation of an active extract of the pancreas in the Toronto laboratories. This story, which is now well known, has been traced historically in this book and the chemical and physiological information concerning insulin has been brought very readably and exhaustively up-to-date. Clinical reviews have been omitted, the more strictly scientific aspects of the insulin problem being dealt with.

The book is highly informative concerning the methods of isolation of the hormone; the physical, chemical and physiological properties; the mechanism of its action; standardisation; possible substitutes of insulin, both synthetic and obtained from natural vegetable sources. As the authors state, the monograph is mainly meant for the specialist and there is a wealth of original references at the end of each chapter, which should be eminently helpful to those who wish to consult the sources. Although a vast amount of work has been done on various aspects of insulin, the insulin problem is far from being solved and one should be able to find indications in the book of profitable lines of study.

The book is printed in modern style and there are some beautiful photomicrographs. It also appears to be remarkably free from errors. The book will doubtless benefit not only those who are engaged on this subject but also workers on other biochemical problems, as it is not unoften that in biochemistry, in particular, results obtained in one field of study have unexpected and important implications in another.

B. C. G.

Sulphuric Acid Manufacture. By Andrew M. Fairile. (American Chemical Society Monograph No. 69.) (Chapman & Hall Ltd., London; Reinhold Publishing Corporation, N. Y.) 1936. Pp. 672. 48*s.* 6*d.* net.

There have been few books in the English language which attempt to bring within the compass of a single handy volume, an authoritative compilation on the modern methods in sulphuric acid manufacture. It is a very big task to sift from a mass of detail the more outstanding developments. The author, in our opinion, has achieved remarkable success with comparatively few shortcomings. The book describes both the Chamber and Contact processes as practised in various countries and deals in some detail with a number of important improvements in the industry which have been developed and placed on a working basis within the last decade. Though the author apparently shows a bias in favour of modern American practices by describing them in greater detail, it should be conceded it is done fairly. Modern American practice in the contact processes should be acknowledged as ahead of all other processes in different countries in the number of outstanding achievements; the newer Brimstone contact plant including the new sulphur burners, sulphur spray nozzles for molten sulphur, sulphur fired steam boilers popularising the use of newer vanadium mass which is increasingly appreciated, self-contained heat exchange converter, etc., may be said to be due to American enterprise.

The liquid-cooled chambers of the new Mills-Packard and Gaillard-Parrish's types and new tower process are also described with up-to-date details of equipment and methods of operation. There is also an interesting chapter on choice of process and trends in the industry. The future of the

sulphuric acid industry cannot but present an intriguing problem; definite tendencies are already somewhat looming on the horizon which are likely to reduce somewhat the importance of sulphuric acid as a basic chemical in heavy chemical industry.

A number of pages have been filled with some details of the famous Seldon-mansanto dispute on the vanadium contact mass which, though interesting, are, we feel, rather out of place and may well have been avoided as they increase the bulk of the book. Apart from this, the book is, in our opinion, well worth a place in the library of all chemists interested in chemical technology. It is an American Chemical Society Monograph and needless to mention is of excellent get-up. The price, however, appears to be rather on the high side.

B. H. K.

The New Acoustics. By N. W. Mc Lachlan. (Oxford University Press, London.) 1936. Pp. vi + 166. 7*s.* 6*d.*

The study of Acoustics has so far been made from a practical standpoint and much has to be done by way of theory to explain the practical observations.

From the above view-point, the subject has been treated by the author in a practical manner describing the various developments from the little known acoustic engineering of the 19th century down to the present date.

The chapters on loud-speakers are dealt with at great length with special attention for the assistance to the designer.

It is interesting to note that the mechanical systems of the devices such as microphones, pick-ups, sound box, loud-speakers, etc., are transformed into corresponding electrical analogue. The treatment of the subject is thereby rendered easy as the phenomena of the electrical circuits are well known. Perhaps this is the only way in which one can study acoustics analytically.

Just as the individual devices (pick-up, microphone, etc.) are dealt with at length in the book, the problem of acoustics in the design of talkie houses, motion picture studios, lecture halls, gramophone recording studios, broadcasting studios, etc., is not treated in detail. The reverberation properties or the absorption conditions of such buildings are facing the present-day designer. It is hoped that more detailed figures on these subjects will be available before the second edition of the book appears.

Differential Equations in Applied Chemistry. By F. L. Hitchcock and C. S. Robinson. (Chapman and Hall, Ltd., London.) Second Edition, Revised and enlarged, 1936. Pp. viii + 120. 7*s.* 6*d.*

In six interesting and well written chapters the authors have set upon themselves the task of teaching mathematics to Chemists and Chemical Engineers. The scope of the book and the concept of Calculus are put forth in popular language in the first chapter. The next three chapters deal with the processes of the first order, the second order and the simultaneous processes usually met with in Physical Chemistry. A proper emphasis has been given to graphical and numerical work. The use of semi-log property, and finding the best line through a set of points, which are usually not easy for a beginner are clearly discussed. The last two chapters are the most important ones for the Chemical Engineer. Chapter V treats of the principle of extraction, intermittent and continuous.

One excellence of this book is the happy choice of the problems at the end of each chapter and the miscellaneous examples at the end of the book. It appears that throughout, the requirements of the Chemical Engineer are constantly kept in view. The subjects treated in these problems comprise a variety of unit processes like flow of fluids, air conditioning and ventilation, drying, crushing, extraction, adsorption, heat transfer, filtration, desalting of hides, etc.

The book is to be warmly recommended to every student of Chemical Engineering.

B. S. SRIKANTAN.

Chapters in Organic Chemistry. By S. V. Divekar. (The Standard Publishing Co., Bombay.) First Edition, 1936. Pp. xxxv + 478. Price Rs. 7–8–0.

This book is intended to help the students studying mainly for the B.Sc. Examination of the Bombay University and is expected to be useful also for students preparing for similar examinations. It is not intended to replace any text-book but is meant to avoid the difficulties which the students have to

take to refer to several standard text-books and Journals. Chapters are devoted for the following topics :—

Purines, Heterocyclic compounds, Indigo, Alkaloids, Terpenes, Diketones, Polymethylenes, Carbohydrates, Enzymes, Plant pigments, Tannins, Organo-metallic compounds, Orientation, Determination of Structure, Reagents in Organic Chemistry, Reactions, preparation of 20 compounds of commercial importance.

Such a compilation will no doubt be popular amongst students preparing for examinations but will deprive the students of the necessary training they must have in referring to standard works and Journals. Some of the chapters have been dealt with in detail and will be useful for students preparing for the Honours course in Chemistry.

A chapter on stereo chemistry might have been added to the great advantage of the students. References to original papers would have helped the students desirous of getting more detailed information. The printing, get-up and binding are satisfactory.

H. S. J.

Protozoa-Ciliophora. By B. L. Bhatia, *Fauna of British India Series* (London, Aug. 1936).

The pioneer researches on Indian Protozoa were carried out by Dr. H. J. Carter of the Medical Service of the East India Company, who during the years 1856–1869 published a series of papers on the Infusoria of the island of Bombay in the *Annals and Magazine of Natural History*. Since this date work of a more or less sporadic nature has been carried out in different parts of India, and a detailed summary of it is given on pp. 10–12 of the Introduction of the volume under review.

The author has followed the latest classification and nomenclature of Protozoa and has, therefore, adopted the term Ciliophora (Doflein) including the classes Ciliata and Suctoria for the subphylum which is dealt with in his volume. In a fairly comprehensive introduction the author deals with the position of Ciliophora in the animal kingdom, a history of the study of the group in India, its classification and phylogeny, the geographical distribution of the free-living Indian forms and distribution with hosts of the parasitic forms, and in a final chapter are included details regarding the technique that should be followed for the study of these interesting but rather difficult animalcules. In the work 310 species belonging to no less than 104 genera are described. The descriptions of 68 species of 48 genera, of which one genus and 16 species are new to science, are the result of the author's researches. In the systematic account the author has given sufficiently detailed descriptions and keys for the identification of all families, even though several of them are not represented in India. This account would materially help in future work, as there is every likelihood of many more forms being discovered when more extended work is carried out in different parts of the country.

The author has been working on Protozoa for over 20 years and was, therefore, in a particularly happy position to deal with this very difficult group. The volume will be a lasting tribute to the painstaking way in which the work has been carried out, and it is hoped that its publication will attract more workers to study these difficult forms. The work is copiously illustrated with 214 text-figures and 11 halftone plates, and a bibliography of nearly 50 pages shows how scattered is the literature on these interesting animalcules. Both the author and the editor deserve the thanks of all workers in this country on the publication of this interesting volume.

B. P.

Outlines of General Zoölogy. Horatio H. Newman. (The Macmillan Company, New York.) 1936. Pp. 661 + xxvii. 15*s*.

The writer of this interesting treatise, the third edition of which we have received, was the director of a freshman survey course,—*The Nature of the World and of Man*. This attempt resulted in the birth at the University of Chicago of four main courses forming the essentials of the New Plan. So much so the *type method*, universally adopted in teaching institutions, is considerably improved and the book based upon this New Plan system commences by discussing in the first few pages, problems connected with life, protoplasm and the cell ; then a discussion of types from amœba to frog and finally the general biological

principles follow. The book is divided into six parts and they are: (1) Biological Science and its History; (2) General Biological Principles; (3) Representative Animal Types (Invertebrates); (4) The Phylum Chordata; (5) Biological Mechanisms in General and Mechanisms of Individual Maintenance and Adjustment; (6) Mechanisms of Racial Maintenance and Adjustment (Evolution and Genetics).

At the end of each chapter, in all these six parts, there is a relevent summary. A bibliography and glossary make the book more useful.

The get-up of the book is excellent and we anticipate that in the next edition a chapter on modern experimental zoölogy will also be included. We recommend the book to every student and professor of zoölogy.

L. S. R.

An Index of the Minor Forest Products of the British Empire. (Published for the Imperial Economic Committee, London, 1936. H. M. Stationery Office.) Pp. 116. 5*s*. net.

An influential and representative Sub-Committee of the Imperial Economic Committee has compiled, with the co-operation of the several governments concerned, this Index. *Minor Forest Products* are understood as "any product of the natural forest, other than timber and its derivatives." The material has been arranged under the following groups :—Drugs and Spices; Dyes; Essential Oils; Fibres; Gums and Resins; Oils and Oil-seeds; Tanning Materials; Miscellaneous. Against each commodity is mentioned its present export trade and future export potentialities. A well-arranged Bibliography which avowedly is indicative rather than exhaustive together with an alphabetical list of the commodities at the end of the volume make for easy reference.

So far as Indian minor forest products are concerned, the *Index* reveals that data relating to some of the important products exported to non-Empire countries are very incomplete. Thus, although the export of the Indian Kuth (Costus root) to China is considerable, no figures relating to this commodity are available. Similarly, no data apparently exist about Cashew Nut the export of which is a flourishing activity in the Konkan.

The inclusion of *Eucarya* Spp., *Osyris tenuifoliata*, *Santalum album* and *Santalum yasi* all under "Sandalwood oil," while making for comprehensiveness is not indicative of the widely varying properties, and the prices which these products fetch in the world markets. This is mentioned here not as a criticism but to convey an idea of the scope of the *Index* whose aim was merely to tabulate the results of a survey of the Empire minor forest products as a first step to promote their use and "to develop the trade in them between Empire countries". The Committee thus set themselves a well-defined and limited task. The *Index* completely answers this purpose and should be of use to those interested in the utilisation of Empire minor forest products.

EMMENNAR.

Magnétisme et Electricité Terrestres. Par Ch. Maurain. Fascicule I—Magnétisme Terrestre. (No. 287 of Actualités Scientifiques et Industrielles. Hermann et Cie, Paris.) 1935. Pp. 63. 15 *fr*.

The projected fitting out of the non-magnetic ship "Research" to replace the "Carnegie" lost in 1929 demonstrates the importance attached to observations of terrestrial magnetism and electricity. The book before us is an authoritative resumé of the subject of terrestrial magnetism with references to telluric currents and polar auroras which are all closely interrelated, and is written by a savant who has devoted most of his time to improving our knowledge of the subject. The account is clear, balanced and impartial, qualities which are even more welcome in a field where so many partially successful theories are competing for mastery. The book may unreservedly be recommended to all those who wish to acquire a correct perspective of an important subject.

Statistical Research Memoirs. Vol. I. Edited by J. Neyman and E. S. Pearson. (Cambridge University Press.) 1936. Pp. 161. 15*s*.

This is the first of a new series of memoirs which will contain papers prepared in the Department of Statistics of the London University. The ambition of this department is "to contribute towards the establishment of a theory of statistics on a level

of accuracy which is usual in other branches of mathematics." The present volume is aptly dedicated to the memory of the late Professor Karl Pearson (1857–1936) who was one of the most outstanding personalities in the development of mathematical statistics. The memoirs will be edited by Professors J. Neyman and E. S. Pearson. The printing and get-up (by the Cambridge University Press) are beautiful.

In conformity with the expressed ambition of the department, the papers published in this volume mostly relate to the theory of testing statistical hypotheses—a subject which is being studied at great length in recent years by J. Neyman and E. S. Pearson as well as by other writers. The following brief introductions of some of the papers will indicate their scope.

(1) "Contributions to the Theory of Testing Statistical Hypotheses, I." By J. Neyman and E. S. Pearson.

Let $x_1, x_2, \ldots . x_n$ be the observed system of variables, and let them be represented by a point E in n-dimensional space W. Let P (Eϵw) denote the probability that the point E falls inside the region w of W. Any assumption concerning the nature of P is called a statistical hypothesis. We assume that a function $p(x_1, \ldots . x_n) = p$ (E) exists which is positive and continuous in almost any point of W such that $\int_w p\ (E) = P\ \{E \epsilon w\}$. Any test of a statistical hypothesis H_0 may be considered as equivalent to a rule of rejecting H_0 whenever the sample point E falls within a certain "critical region" w and in accepting it in all other cases. The probability of the first kind of error determined by H_0 is the size of the corresponding critical region w. The probability of rejecting H_0 when an alternative H′ is true has been termed the power of the test with regard to H′ The most powerful test for H_0 with respect to H′ is the test whose power is greater than that of any other equivalent test, and the critical region associated with this test has been termed the best critical region w_0 for H_0 w.r.t. H′. If w_0 is independent of the alternative hypothesis H′, the test H_0 is called a "uniformly most powerful test". A theory based on these definitions has been developed in the authors' papers elsewhere. The present paper discusses cases where a solution along these lines is not possible—cases where it is not possible to find a single region which minimises the risk of accepting H_0 falsely whatever alternative H′ be true. The problem of determining "unbiassed critical regions" for such cases, forms the central theme of the paper.

(2) "An investigation into the application of Neyman and Pearson's L_1 Test, with Tables of Percentage Limits." P. P. N. Nayer.

Let the observations of a variable quantity x fall into k groups and let x_{ti} be the ith observation in the t th group. If the populations are normal, the test H_1 that the k independent samples have been drawn from populations having the same S. D. σ is by considering the expression

$$L_1 = \frac{\left[\prod_t \left\{\sum_i \left(x_{ti} - \bar{x}_t\right)^2\right\}^{n_t}\right]^{1/N}}{\sum_t \sum_i \left(x_{ti} - \bar{x}_t\right)^2} \times \prod_t \left(\frac{n}{n_t}\right)^{n_t/N}$$

with the usual symbology. The hypothesis H_1 requires that L_1 (which lies between 0 and 1) is not very near to zero. Neyman and Pearson who have advanced this test expect that if H_1 is true, the sampling distribution of L_1 may be approximately represented by a Pearsonian curve of Type I:

$$p\ (L_1) = \frac{\Gamma\ (m_1 + m_2)}{\Gamma\ (m_1)\ \Gamma\ (m_2)} L_1^{m_1 - 1}\ (1 - L_1)^{m_2 - 1}$$

The adequacy of this approximation is studied in some detail in the present paper, and tables of 5% and 1% probability levels for L_1 are given when n_t is constant.

(3) "Tests of Certain Linear Hypotheses and Their Application to Some Educational Problems." Palmer, O. Johnson and J. Neyman.

Following the general ideas of testing hypotheses developed by Neyman and Pearson, and of St. Kolodziejczyk's test for "linear" statistical hypotheses the authors discuss a broad class of educational problems which can be reduced to those of testing linear statistical hypotheses.

(4) "On the Analysis of k Samples from Exponential Populations with Especial Reference to the Problem of Random Intervals." P. V. Sukhatme.

If a series of events occur randomly in time (or space) the frequency of these events occurring in a given interval of time (or space) follow a Poisson distribution. A second method of attack to examine the random occurrence of the events is based on the analysis of the intervals between the

events occurring at random. The present paper explains how tests may be developed based on the distribution of intervals between random events, analogous to the "Analysis of Variance" tests of R. A. Fisher for the case of normal law variation. The methods are illustrated by telephone and accident data.

(5) "Tests of Statistical Hypotheses in the Case when the Set of Alternatives is Discontinuous, illustrated on some Genetical Problems." Robert W. B. Jackson.

Let H_0 be a simple hypothesis to be tested, Ω the test of simple hypotheses which are considered admissible. Following the notations of papers on this subject, the set Ω is defined as continuous if whatever the hypothesis H_0 belonging to Ω, whatever the region w in the sample space, and whatever $a > 0$, it is possible to find within Ω another hypothesis H_1 different from H_0 such that

$$| P \{E\epsilon w \mid H_0\} - P \{E\epsilon w \mid H_1\} | < a.$$

The theory of testing statistical hypotheses so far developed applies mainly to the case where Ω is continuous. When the set of admissible hypotheses is discontinuous, a test called the most stringent test has been developed in this paper, based on the consideration of the total probability of errors of all kinds involved in the testing.

C. N. S.

The Mathematics Student. Vol. IV, No. 1. (Published by the Indian Mathematical Society.)

This number is mainly devoted to the Proceedings of the Ninth Conference of the Indian Mathematical Society, held at Delhi in December 1935. The address of welcome by Rai Bahadur Ram Kishore, the opening speech by Sir Girja Shankar Bajpai, the Presidential Address by Dr. R. Vaidyanathaswamy, and the substance of a public lecture on Cosmography by Prof. A. C. Banerji, are printed in full. The Presidential Address on "Mathematics and Modern Physics" discusses the mathematical concepts of "Group" and "Eigen-value" with reference to physical problems, and will be well appreciated as coming from a talented thinker. One sentence which deserves to be quoted is the following: "The whole theory of Eigen-values may be regarded as the generalisation of the idea behind the theorem that an ellipsoid has always three mutually perpendicular principal axes, or in more general form, two conics have in general a unique common self-polar triangle."

A paper "On Quadratic Equations" by Prof. A. Narasinga Rao concludes the present number. The following explains the gist of this paper:

A (1, 1) correspondence is set up between quadratic equations and points of a plane by taking (a_0, a_1, a_2), the homogeneous coordinates of a point correspond to the equation $a_0 x^2 - 2a_1 x + a_2 = 0$. The points of the conic $\Omega \equiv xz - y^2 = 0$ correspond to equations with equal roots. Then it follows that conjugate points $w.r.t.\ \Omega$ correspond to a polar quadratics, and all quadratics with a common root t correspond to points on the tangent to Ω at t.

A very interesting method of proof to show that generators of the same system on a quadric in [3] do not intersect while generators of opposite systems intersect is given by what the author calls as the "Lie representation" of oriented quadratic equations. If t_1 and t_2 are the roots taken in a certain order, of $a_0 t^2 - 2a_1 t + a_2 = 0$, consider the point (a_0, a_1, a_2, a_3) in 3-space, where $a_3 = a_0 (t_1 - t_2)$. This point lies on the quadric surface $a_3^2 = 4 (a_1^2 - a_0 a_2)$. The quadric with roots t_2 and t_1 is then represented by $(a_0, a_1, a_2, -a_3)$. In terms of (t_1, t_2), the point (a_0, a_1, a_2, a_3) may be written $1, \frac{1}{2}(t_1 + t_2), t_1 t_2, t_1 - t_2$. Hence equations with $t_1 =$ constant, correspond to one system of generators while equations with $t_2 =$ constant correspond to the opposite system of generators.

These concepts are briefly extended to cubic equations, oriented and non-oriented.

C. N. S.

Laterite.*

DURING the last few years, the question of the exact character and mode of origin of Laterite has come in for a lot of comment by geologists both in India and abroad. The term 'laterite' was first used by Dr. Francis Buchanan, so far back as about 1800; and for more than a century now this term has been so commonly employed by a number of field geologists in describing certain deposits in different parts of India, that one often wonders whether all these 'laterites' of different authors are really the same kind of material, both in constitution and mode of formation. From a perusal of the literature, it was obvious that the term had been often loosely employed, with the result that in any discussion of the nature of laterite in general, there was ample room for confusion and controversy. Geologists were thus not quite happy concerning the nomenclature of laterite and many of them naturally felt that for any useful or profitable discussion of problems connected with laterite, it was desirable to have, at the outset, an exact account of Buchanan's original laterite from his type areas in Malabar. This work Dr. Fox undertook in November 1933 and the result is the 'informing and authoritative' paper which has just been published by him on Buchanan's Laterite of Malabar and Kanara.

In this paper Dr. Fox has, to begin with, given a number of extracts from Buchanan's descriptions to give us an idea of what exactly he (Dr. Buchanan) was thinking of when he used the term laterite. All the laterite occurrences in Malabar, Kanara and Shimoga are associated with granitic rocks below, and are seen to pass down into them through a zone of kaolinised rock. There is thus no doubt that the laterite has been formed from such acid rocks. It is not possible to say in the field whether this vermicular soft laterite contains hydrated alumina or hydrous silicate of alumina. Since it is clearly on this point that the whole modern nomenclature depends, a few typical samples were immediately analysed. The results obtained were extraordinarily surprising. From these analyses it was evident that Buchanan's 'Laterite' is really a vermicular lithomarge, with a considerable amount of ferric hydrate present in the upper part—and is not a true laterite according to the generally accepted sense of the term as representing "an earthy residuum of aluminium trihydrate (in its crystalline form of gibbsite), limonite, a few unaltered fragments of felspars, in some cases secondary quartz, and the various resistant minerals originally present in the rock."[1] According to J. B. Scrivenor[2] the formation of laterite and the process called 'lateritisation' consist "in the formation of aluminium hydrate from silicates as an end-product of weathering instead of hydrated silicate, which is regarded as the usual end-product of weathering in temperate climes. The theory is that in tropical regions, the hydrated silicate is formed, but undergoes further decomposition, whereby the silica is removed in solution and aluminium hydrate remains." Thus the term 'Lateritisation' refers to an end process of weathering beyond that of kaolinisation, whereby the hydrated silicates break down into the hydroxides of alumina which remain and silica which is removed in solution; and it is thus obvious that in nature, there can be rocks representing every stage in this process from the formation of kaolin or lithomarge to the final condition practically devoid of silica, and with aluminium hydroxide and ferric hydrate as the two essential components—a condition nowhere fulfilled by Buchanan's laterite. From Dr. Fox's studies it is clear that Buchanan's original laterite in his type area, consists mainly of what we should now call 'lithomargic laterite' or even 'lateritic lithomarge' which marks only an earlier stage in any process of true 'lateritisation'.

This important conclusion arrived at by Dr. Fox is of great value since it clarifies our position in all future discussions bearing on laterites, and his present paper will be welcomed by all geologists, both in India and abroad, as an authoritative and masterly contribution leading to a clear and proper understanding of the exact character of laterites in general.

L. RAMA RAO.

* C. S. Fox, "Buchanan's Laterite of Malabar and Kanara," *Rec. Geol. Surv. Ind.*, **69**, Pt. 4.

[1] Sir John Harrison, "The Katamorphism of Igneous Rocks under Tropical Conditions," *Imp. Bur. of Soil Sci. Eng.*, 1934.

[2] J. B. Scrivenor, *The Geology of Malaya*, 1931.

OBITUARY.

Dr. Arthur Henderson Mackenzie, M.A., D.Litt., C.I.E., C.S.I.

DR. ARTHUR HENDERSON MACKENZIE, late of Hyderabad, died on Saturday, the 26th September 1936, at the age of 56. He was born in February 1880 and received his University Education at Aberdeen. He came over to India in 1908, as Inspector of Schools in the United Provinces. He successively held a series of responsible posts, Principal, Training College, Allahabad (1909–1920), Chief Inspector of Vernacular Education, U.P. (1920–21) and Director of Public Instruction, U.P. (1921–1934). He then left U.P., where he had spent 26 years, to take up the appointment of Pro-Vice-Chancellor of the Osmania University. Dr. Mackenzie was appointed Education Commissioner with the Government of India, in which capacity he had officiated for one year in 1930, but ill-health prevented him from accepting the appointment. He was decorated with the C.I.E. in 1928 and with the C.S.I. in 1933.

Dr. Mackenzie was responsible for the proposals of reorganisation of education in Hyderabad, resulting from the appointment of an enquiry committee known as the Mackenzie Committee. He was a member of the Quinquennial Reviewing Committee of the Indian Institute of Science, which was appointed by the Government of India to review the working of the Institute with Sir James Irvine as Chairman. His death will be a severe loss to his numerous friends.

CENTENARIES.

S. R. Ranganathan, M.A., L.T., F.L.S.

Shippen, William (1736–1808).

WILLIAM SHIPPEN, the pioneer anatomy teacher of the New World, was born in Philadelphia on October 21, 1736. His father was one of the prominent medical men of his day. Having graduated at the College of New Jersey in 1754, he studied medicine under his father till 1757. In those days, there was no regular medical college in America. The youth of that period, destined to a medical career, was at an early age indentured to some reputable practitioner, to whom his service was successively menial, pharmaceutical and professional. Ambitious spirits, seeking to have a more assured and inspiring discipline, resorted to the hospitals and lecture halls of Leyden, Paris, London and Edinburgh. William Shippen was one of the first such men. He crossed the Atlantic in 1757. He studied in London chiefly under William Hunter and Colin McKenzie and received much help from John Fathergill. In 1761 he received the M.D. of Edinburgh and later visited the chief medical schools of France.

IS MOBBED FOR DISSECTING.

Shippen was one of the pioneering type of eighteenth century American youths, who, on returning to their native land, sought opportunities to share with their less fortunate or less adventurous fellows the rich experience gained as they "walked the hospitals" of the Old World. The voices of the great European masters of that day thus re-echoed in the New World. High scientific and professional ideals impelled these youthful enthusiasts, who bore their lighted torches safely back across the waters. In 1762, the very year of return, Shippen began a course of lectures on midwifery. In the following autumn, he announced a series of anatomical lectures "for the advantage of the young gentlemen in this and neighbouring provinces, whose circumstances and connections will not admit of their going abroad for improvement to the anatomical schools of Europe, and also for the entertainment of any gentleman who may have the curiosity to understand the anatomy of the human frame." In this course, he introduced, for the first time in America, the dissection of human bodies as part of the instruction. This aroused the animosity of the populace. His dissecting rooms were mobbed on several occasions, and once he narrowly escaped with his life. Slowly the prejudice died out however and the number of students increased year by year.

FOUNDS THE FIRST MEDICAL SCHOOL.

From these detached courses, the step to an organised medical school was taken in

collaboration with a friend and fellow-student abroad, John Morgan. The trustees of the college of Philadelphia were approached and in 1765 a medical school was established as part of the college and intimately connected with the Pennsylvania hospital, established thirteen years earlier through the efforts of Thomas Bond and Benjamin Franklin. William Shippen became the first professor of anatomy and surgery in this school, which was the first of its kind in America. The first batch of ten Bachelors of Medicine graduated from this school in 1768. When the legislature repealed the charter of the college of Philadelphia in 1779 and created the University of the State of Pennsylvania, he accepted the Chair in the new school. In 1791, when this University gave place to another University under the name of the University of Pennsylvania, he was again appointed Professor of Anatomy, Surgery and Midwifery.

His Influence.

Shippen was also one of the Founders of the College of Physicians of Philadelphia and he was its President from 1805 to 1808. Speaking at the centenary celebration of the College on the 3rd January 1887, Sir William Osler included Shippen among those who, by their reputation and service to medical science, belong not to Philadelphia alone but to the history of the profession. A more detailed and eloquent tribute was paid by Osler, ten years later, on the first of September 1897 in his address on "British Medicine in Greater Britain" at the meeting of the British Medical Association in Canada. Osler said, "A physician may possess the science of Harvey and the art of Sydenham and yet there may be lacking in him those finer qualities of heart and head which count for so much in life... Medicine is seen at its best in men whose faculties have had the highest and most harmonious culture..... And the men of this stamp in Greater Britain have left the most enduring mark—Beaumont Bovell.... Morgan, Shippen.... Brahmins all, in the language of the greatest Brahmin among them, Oliver Wendell Holmes—these and the men like unto them have been the leaven which has raised our profession above the dead level of business."

The End.

In 1798, occurred the death of the only son of Shippen a young man of great promise. After this, he seems to have lost interest in life. His health gradually declined, his practice fell off and he seldom lectured. He died at Philadelphia on the 11th July, 1808.

Lax, William (1761–1836).

WILLIAM LAX, a British astronomer, was born in 1761. He had his University education at Trinity College, Cambridge. He graduated in 1785 as senior wrangler. He was also the first Smith's prizeman of his year. He was elected a Fellow of his college in 1788. William Lax succeeded Dr. Smith in 1795 as Lowndes's Professor of Astronomy and Geometry in the University of Cambridge. After some years of teaching work, he was presented by Trinity College to the livings of Mersworth, where he built a small observatory.

His Writings.

In 1807, he published his *Remarks on a Supposed Error in the Elements of Euclid.* The Board of Longitude published his *Tables to be used with the Nautical Almanac*—the first edition in 1821 and a second one in 1834. Two of his papers appear in the *Transactions* of the Royal Society of London: *A method of finding the latitude of a place by means of two altitudes of the sun* (1799) and *On a method of examining the divisions of astronomical instruments* (1808). The method proposed by Mr. Lax in the latter paper, though very ingenious, required great labour and time and was pronounced to be inferior in accuracy and efficiency to that proposed by Troughton in the same volume of the *Transactions.*

He died on the 29th October 1836, at the age of 75.

Hough, George Washington (1836–1909).

G. W. HOUGH, the American astronomer, was born on October 24, 1836, at Tribes Hill, New York. He was descended from German ancestors who migrated from Würtemburg in 1730. He is said to have inherited a mechanical genius from his father. Two early evidences of this are recorded. They both relate to his ninth year. It would appear he harnessed up a small brook to run his mother's churn, and

that he constructed a contrivance from fish poles for measuring the right ascension of a star. He graduated with high honours at New York in his 20th year. After being a teacher for a couple of years, he entered Harvard University and obtained the Master's Degree in 1859.

CAREER AS ASTRONOMER.

In the same year, he became an assistant astronomer under O. M. Mitchel at the Cincinnati Observatory. Next year he went with his chief to the Dodley Observatory at Albany. Two years later, *i.e.*, 1862, he succeeded his chief and continued as Director till 1874. At this time, there was a break from astronomy to commercial pursuits for five years. Then, in 1879, he resumed astronomy as Director of the Dearborn Observatory which was first at Chicago and then at Evanston. He kept to this post till his death. Throughout this long period of thirty years, he was also Professor of Astronomy, first at the Chicago University and later at the North Western University.

HIS CONTRIBUTIONS TO METEOROLOGY.

While at Dudley, his time was largely devoted to meteorological work, although he did some astronomical work such as the observations of the declination of stars, observations of Neptune, of asteroids, etc. It was during the fourteen years of residence in Albany that he invented his printing barometer, his self-recording thermometer, his printing chronograph and his anemograph. His printing barometer won for him a Gold Medal at the Centennial Exhibition in Philadelphia in 1876 and at the World's Fair in Chicago in 1893. During his Dudley period, he also led a total solar expedition to Matoon in 1869.

HIS CONTRIBUTIONS TO ASTRONOMY.

Throughout the thirty years he was at the head of the Dearborn Observatory, his output of astronomical work was unceasing. Almost in the first year, he commenced the study of the planet Jupiter, which he continued up to his death. The *Annual Reports* of the Chicago Astronomical Society contain a mass of his micrometric studies of all the jovian phenomena especially of the great red spot and the equatorial belts, the value of which is greatly enhanced in that they were made by *one* man throughout a period of thirty years. Another field in which he distinguished himself during this period is that of double stars. With the 18½-inch refracter of Professor Burnham, he measured a large number of double stars and discovered no less than 648. Among the discoverers of double stars he ranks fourth, the other three being Burnham, Aitken and Hussey. Out of more than 10,000 double stars studied, only one is known which is of as short a period as Hough's No. 212 (13 ceti). His work on double stars have been collected by Prof. Doolittle in Volume 3, part 3 of the *Publications of the University of Pennsylvania*. On the instrumental side, his chief invention of this period is the moving dome and adjustable observer's chair, which have been widely adopted by other observatories.

HIS HONOURS.

Reference has already been made to the recognition which his printing barometer brought him. In 1891 he received the honorary degree of Doctor of Laws from Union College and got elected to the British Astronomical Association. In 1893, he was President of the Mathematics and Science section of the World's Congress in Chicago. In 1903, he was elected an Associate Member of the Royal Astronomical Society of England. He was also a member of about ten other learned societies and a Vice-President of the American Association for the Advancement of Science. He was considered an outstanding authority on all matters connected with Jupiter.

Sham and ostentation were foreign to his nature. In character, he is said to have been of a quiet and unassuming but of an affectionate, genial disposition. His learning and knowledge were vast and very wide in their scope. He never spoke hastily nor too much, and his opinion on a subject was always worth having.

Death came suddenly and painlessly to him on the New Year's morning of 1909, at about ten o'clock.

RESEARCH NOTES.

BIOLOGICAL.

Ascorbic Acid and Glutathione.—The relation between ascorbic acid and glutathione, first recognised by Szent-Györgyi and since assuming great importance as one of the possible factors in the physiological rôle of the vitamin, has been established clearly now by Hopkins and Morgan (*Biochem. J.*, 1936, **30**, 1446–1461). They find that such a relation between these two biologically important compounds is brought about through the intermediary of hexoxidase (ascorbic acid oxidase), which, while being specific for ascorbic acid when alone, and therefore by itself without action on pure glutathione, however oxidises the tripeptide in presence of the specific substrate. Hence in the system ascorbic acid—oxidase-glutathione, the oxidation of ascorbic acid by its oxidase commences and proceeds normally only after all the glutathione in the system has been oxidised. Under anærobic conditions this oxidation of glutathione by oxidised ascorbic acid + oxidase is very much faster than under ærobic conditions in the presence of the enzyme. Thus this oxidase seems to be more energetic to activate oxidised ascorbic acid as an hydrogen acceptor for glutathione, than to activate reduced ascorbic acid as a hydrogen donator for oxygen. In effect, glutathione apparently protects ascorbic acid from being oxidised by its specific enzyme.

Actually, however, glutathione does afford, a protection to ascorbic acid from oxidation catalysed by copper, thus explaining the now well-known capacity of the copper-containing hepatic tissues to inhibit autoxidation of ascorbic acid.

Insulin and Glucagon.—Professor Max Burger of Bonn and co-workers who succeeded in preparing Insulin in a pure crystalline form, have been comparing the physiological action of the crystalline substance with that of the common "Insulin" of commerce. The investigation has yielded results, some of them unexpected, which are recorded in *Forschungen und Fortschritte* (1936, **12**, 308). While the commercial Insulin causes on administration first a primary increase in the blood-sugar content (followed, of course, by a secondary and more than corresponding diminution), the pure crystalline substance did not produce the primary increase. Further work showed that the peculiar action of the commercial Insulin was directly traceable to Glucagon, a substance present in pancreas. Glucagon has the closest resemblance to Insulin, both being protein-like bodies with practically identical C, H, N and S contents. But Glucagon has a reduction value slightly lower than that of pure Insulin, is adialysable and is adsorbed by a variety of media. Its potency, unlike that of pure Insulin, is not affected by salt solutions and by cystine. The purest specimens of Glucagon which Prof. Burger could prepare raised the blood-sugar content, on injection to normal rabbits in a dosage of 20 γ/Kg., by nearly 50% of the original value for a period of 40 to 60 minutes. It was also found that most of the commercial samples of Insulin examined contained, in addition to Glucagon, traces of other substances which are presumably responsible for the skin maladies which are occasionally met with in the application of Insulin therapy. The standardisation of Insulin dosage is, therefore, not so simple as it was first thought to be. Expressing the physiological strength of Insulin as the product of its sugar diminution capacity ("depth" of action as Prof. Burger calls it) and the period during which its action is effective, it is found that crystallised Insulin has about double the strength of the international standard Insulin.

Further work has shown that the physiological action of crystalline Insulin is not confined to the carbohydrate economy of the body. The synthesis of fats in the organism is increased and the oxidation processes are accelerated. Prof. Burger's work, in addition to having materially contributed to our knowledge of the properties of pure Insulin, has rendered a more precise standardisation of the substance possible.

EMMENNAR.

Pollen Grains of Angiosperms.—The study of a large number of species has enabled Geitler (*Planta*, 1935, **24**, 361–386) to confirm Goebel's opinion that the pollen grains of Angiosperms have a polarity which is related to their position within the tetrad. But, while Goebel thought that the generative cell is always cut off towards the outer wall of the tetrad, Geitler has shown that other positions (towards the centre of the tetrad, or laterally on the radial walls) also occur. The place of formation of the generative cell is constant for each species, but it may vary in related genera: for instance, in *Vaccinium vitis idæa* it is on the outer wall, while in *Erica persoluta* it is towards the centre of the tetrad.

It appears that there is no relation between the method of division of the pollen-mother cells (simultaneous or successive) and the position of the young generative cell. It is only the plasm of the grain, which is responsible for transporting the nucleus to its distinctive place of division and for forming vacuoles at other places. It is also probable that the distinctive direction of the spindle may be due to a polarity of the microspore nucleus itself.

Some of the author's observations on chromosome behaviour also seem to be of great value. Especially interesting is the statement that during metakinesis there is not only a movement of the attachment constrictions to the equator, but that the chromosomes themselves make autonomous movements within the plate so as to attain a radial arrangement, or, when there is less space (as in *Gasteria*), a similar constant position of the long chromosomes. Likewise, in the early telophase also, the chromosomes (especially the long ones) were observed in such positions which tended to bring their distal ends into the nuclear space and gave the impression of autonomous movement.

H. D. WULFF.

Indian Museums.

By E. A. D'abrew.

(*Central Museum, Nagpur.*)

MOST provinces in India have their museums but it is regrettable how very few of these museums have developed a provincial aspect, which should be the foremost thought in their system of development.

Recently there has been a tendency to develop archæology only in these museums to the detriment of other branches and sections. Archæological museums are certainly the easiest to curate whilst biological ones are the most difficult. As archæologists or numismatists are frequently in charge of such institutions, it is natural that natural history and other sections will suffer, although the latter are more popular with the general public.

I visited the Lucknow Museum many years ago and was rather struck by the richness of its natural history collections which only required proper arrangement and labelling to make it into a really good show as many good specimens were already there. Twenty years later, I visited this same museum and found that most, if not all the biological collections had disappeared and had been replaced by other exhibits, among which the only ones of any interest were archæological.

The Lahore Museum is purely an art museum and, although I have not seen it myself, I am told it is badly ventilated and that the natural history section has disappeared long ago; yet the Punjab is extremely rich in animal life peculiar to itself.

I took a peep into the Patna Museum the other day. The building was an imposing structure and I anticipated seeing a horde of Asokan relics, perhaps a whole room devoted to old Pataliputra and Maurian art, but I was disappointed. A fine figure of a ' chauri ' bearer, at the entrance was all I saw and though this was attributed to Asoka's age, the stone showed no signs of age and appeared as if recently carved. The natural history section contained practically nothing of local interest although the province of Bihar is rich in fauna, not to mention the fauna of the Ganges alone. A pair of Pink-headed Ducks were the only decent exhibits; the rest consisted of some local, exotic and domestic birds, mostly badly mounted with illegible or incorrect labels. A good bison head hung on the wall but one of its horns was completely destroyed by dermestid beetles. In this same room were also placed Tibetan head dresses, paints, paintings, sculptures, etc.

The Bombay Museum is perhaps the most up-to-date, particularly in its natural history section, but conditions here are different to what are available in most provincial museums. The natural history section is backed by a society of about 1,000 members interested in natural history, many of whom help in an honorary capacity and besides, the staff is better paid than in most museums.

One defect I found in most archæological museums is that they do not bring the subject home to the layman, nor are the collections arranged in a way to make the subject interesting and guide books are generally not available.

Nowadays most colleges teach biology but even an elementary display of zoological types are non-existent in most provincial museums. I once met a post-graduate student in zoology, who said his thesis had been on the moths of Lahore, yet this same student when shown a Uranid moth, pronounced it to be a butterfly !!

The complaint in most museums is lack of funds and mismanagement by those at the head through want of proper technical knowledge on the subject of museums. Sometimes a few persons who perhaps are uninterested and have never visited a museum are appointed to select a curator and of course the man with the highest degree amongst the applicants is selected, although he may be quite unsuited for the post. The result is that valuable collections already accumulated are lost or rejected before he gets initiated or learns his work.

Then again a person cannot be an expert in all the branches of a museum and it becomes necessary to have assistants for certain sections; this prevents neglect in sections in which the head of the museum is not much interested. A geologist for instance will hardly take an interest in ethnology or an archæologist in zoology and *vice versa*. It is here that the services, if available, of honorary workers, who are experts and keen on the subject, should be enlisted. Perhaps it would be better policy for one man to curate a certain section in two or more museums.

Another point which needs development in local museums are libraries, laboratories and research collections, which should be available to the public. There might also be an Inspector-General of Museums whose duty it would be to go round giving advice and suggestions.

Visits of the staff to other museums should be encouraged, as it may be useful in suggesting new ideas, and it should be open even to junior members of the staff as well as to directors and curators. Museum publications should be encouraged even if they do not profit the museum.

Lastly the man appointed to a museum should be an enthusiast and keen on his subject, and the keener he is the more the museum will improve unless his energies are damped by those above him or by financial stringency.

SCIENCE NOTES.

Need for Research in India on Intergeneric Crosses between *Brassica* and *Raphanus*.—Dr. R. H. Richharia, Agricultural Research Institute, Nagpur, writes :—

Some of our oil seed crops such as mustard and rape belong to the genus *Brassica*. The intergeneric crosses between this genus and *Raphanus* to which radish belongs have been of great interest in recent years especially in demonstrating the experimental production of new species and genera by hybridisation. They are important not only from purely scientific point of view but from economic view-point as well. The interesting Radish-cabbage hybrids, (Karpechenko, 1924–27; Richharia, 1936) Raphano-brassica, are well known (see photograph).[1,2,3] In F_2 from this cross, *Raphanus sativus* (Radish) × *Brassica oleracea* (Cabbage Brussels sprout, etc.) several types of polyploids originate, of which only tetraploids are very fertile and constant. These hybrids are quite huge and vigorous. Their leaves can be used as fodder and fruits as vegetables. During the year 1931–35 a few hybrids could withstand the extreme winter of England (Cambridge), thus were biennial. It is quite possible that under favourable climatic conditions they may be made perennial. In India the question is whether they will be able to survive through the hot season. Experiments from this point of view have been started on this experimental station.

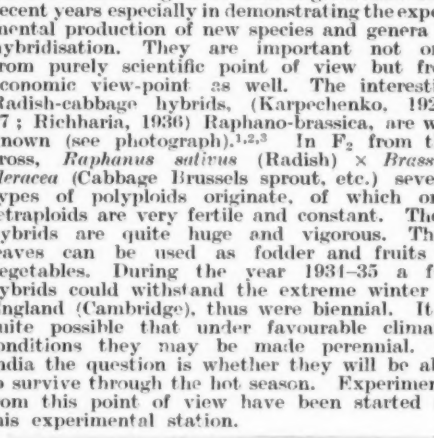

Fig. 1.—Fruits from Tetraploid Raphanobrassica (*Raphanus sativus* × *Brassica oleracea*).

(*a*) A single fruit. The upper half (nearly) is radish part and the lower, cabbage.

(*b*) A branch with feebly developed fruits.

Species such as *B. Carinata* (Abyssinian mustard), *B. chinensis*, etc., also easily cross with Radish (*e.g.*, Karpechenko, 1929; Tarasawa and Shimotomai, 1928; Tarasawa, 1933, etc.).[4,5,6] But F_1 generation in all these crosses is extremely sterile. Occasionally a few seeds may be obtained which in F_2 produce different types of polyploids. It is quite possible that if the different F_1's are grown under various controlled and natural environmental conditions important results may be obtained.

These crosses also open a very promising line of research from the bio-chemical point of view.

The purpose of the above note is to invite the attention, of scientific workers to the possibility of utilising intergeneric crosses between *Brassica* and *Raphanus* as experimental material.

* * *

DR. T. S. WHEELER has returned from leave and resumed charge of office as Principal, Royal Institute (of) Bombay.

* * *

A Note on a Few Rusts from Kolagaon (Nagar District).—Prof. S. A. Parandekar, Rajaram College, Kolhapur, writes :—

Rusts are so common in our fungus flora; by their coloured spots specially on the leaves that they are conspicuous enough to the "rust-collectors".

During a casual visit to Kolagaon (about 15 miles from Kopergaon Railway Station on Poona-Dhond-Manmad Line) in October last, the following three rusts were collected and identified; the identification was later confirmed by Dr. Sydow of Berlin. As these forms are not reported so far from the same locality, it was thought worth while to do so.

1. *Uromyces Aloes* (Cke.) P. Magn. on leaves of *Aloe vera* plants growing on the banks of the river "Umbri" and near by. In this case it was confirmed by observations that the fungus remains dormant during the hot weather and produces the spores in spring and winter on the leaves which apparently look healthy and the infection occurs immediately after the spores mature—a view already expressed with some doubt by Ajrekar and Tonapy,[1] who have reported the fungus previously from Talegaon (Poona District). The same rust is also reported previously from Coimbatore.[2]

2. *Puccinia heterospora* Berk and Curt. on *Sida spinosa* growing in large numbers in the vicinity of the P. W. D. bungalow; this is previously reported from Poona, Dharwar, Mysore and Berars.[2]

3. *Uromyces commelinæ* (Cke.) on *Commelina Forskalæi*, Vahl., Enum. growing on the bank of the irrigation canals (Godavari—Right Bank); this is previously reported on *Commelina benghalensis*, *C. obliqua* and *Cynotis* species elsewhere.[2]

* * *

Expedition to Mount Nanda Devi.—On August 29, the members of the Joint British-American Expedition led by Prof. Graham Brown climbed for the first time Nanda Devi, the highest peak (25,660 ft.) in the British Empire. The members of the Expedition consisting of seven experienced mountaineers, left Ranikhet on the first stage of the journey on July 14th. It was calculated that the party would take about three weeks to reach the base camp at the foot of the Naini Tal gorge.

According to an account published in *Statesman* (Sept. 13th) Messrs. Tillman and Eric Shipton first achieved in 1934 the feat of penetrating into the basin of Nanda Devi. According to Mr. Ruttledge "Nanda Devi is guarded by a 70-mile barrier-ring on which stand 12 measured peaks, over 21,000 feet high and which have no depression lower than 17,000 feet except in the west where the Rishi Ganga rising at the foot of Nanda Devi and draining an area of some 250

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[1] Karpechenko, *J. Genet.*, 1924, **14**, 375.

[2] Karpechenko, *Bull. App. Bot. and Plant Breeding*, 1927, **17**(3), 305.

[3] Richharia, R. H., *Cytological Investigation of* Raphanus sativus, Brassica oleracea *and their* F_1 *and* F_2 *hybrids.* (In press.)

[4] Karpechenko, *Proc. U.S.S.R. Congr. Genet.*, 1929, **2**, 277.

[5] Tarasawa and Shimotomai, *Abstr., Jap. J. Bot.*, 1928, **4**, Entry 234.

[6] Tarasawa, *Proc. Crop. Sci. Soc. Japan*, 1933-35, 107.

[1] Ajrekar and Tonapy, *Journ. Ind. Bot. Soc.*, Sept. 1923, 267.

[2] Butler and Bisby, *The Fungi of India*, 1931.

sq. miles of ice and snow has carved for itself what must be one of the most terrific gorges in the world; two internal ridges converging from the north and south upon the river form the curtains of the inner sanctuary with which the great mountain soars up to 25,660 feet." This defence had previously defeated Dr. Longstaff, Dr. Sommervele, General Wilson and Mr. Hugh Ruttledge. Messrs. Tillman and Shipton entered and left the basin in 1934 by the Rishi Ganga and in the same year reached it again by the same route to emerge by the Sunderdhanga col and valley on the southern rim, after climbing a considerable distance up the south face of Nanda Devi herself.

The triumph of the Expedition is not a little due to the quick movement made possible by the light luggage with which they had provided themselves.

* * *

Siniolehu Conquered by German Climbers.—Yet another triumph of Himalayan Expedition was achieved by the German climbers on September 23rd, when the party led by Herr Paul Bauer reached the summit of Siniolehu (22,620 ft.). The summit was reached at 2 P.M. The last part of the climb from a height of 21,300 ft. up to the summit provided very difficult climbing. The expeditionists hope to climb some of the neighbouring hills.

* * *

North America's Highest Peak.—In a series of four flights from the Pan American Airways base at Fairbanks, Alaska, Mr. Bradford Washburn, leader of the National Geographic Society's Mt. McKinley Expedition, succeeded in photographing a vast expanse of the rugged terrain between Mt. McKinley and Mt. Hayes.

The pictures reveal the highest territory under the American flag. They also mark the first use, in the region, of infra-red ray photography, which makes it possible for the same photograph to show the town of Fairbanks and the white summits of Mt. McKinley and its related peaks projecting above the horizon more than a hundred miles away across a haze-obscured plain.

The infra-red photographs show why Mt. McKinley can claim one of the greatest heights, from top to bottom, among the world's mountains, since it rises 20,000 feet from a level plain almost without foothills. Mt. Everest although 29,000 feet above sea-level, actually rises only about 10,000 feet above a lofty plateau region. Because of its near Arctic latitude, Mt. McKinley has a very low timber line and is forbiddingly barren. Its expanses of snow and glacier do not completely cover all its jagged rocky ridges.

After flying 500 feet above the top of Mt. McKinley, despite dangerous air currents, and circling the peak several times Mr. Washburn flew straight along the axis of the mountains, taking close range photographs in pairs, stereoscopic fashion, at intervals of a minute. He thus obtained a progressive series showing the various peaks in their true relations to one another.

Photographs of Mt. McKinley reveal a giant of almost unrealizable magnitude massive to the very top. Its steeply sloping western face has been called the world's highest cliff—an almost sheer drop of over three miles. The southern side, however, is perhaps more impressive, although only about two miles deep, its wall is perpendicular. Only three expeditions have been known to scale Mt. McKinley.

South Indian Epigraphy.—The annual report for the South Indian Epigraphy for the year 1932–33 just issued, chronicles the activities of the special branch of the Archæological Department, interested in the decipherment of inscriptions discovered in South India. During the years an intense survey in selected parts of the Madras Presidency and Bombay—Karnatak was carried out; 600 inscriptions were copied in 133 villages, the actual number of villages inspected being over 350.

Several inscriptions refer to the Pallava Kings of Conjeevaram and these throw interesting sidelight on the ancient social customs and beliefs. The existence of several unknown kings of the Chanukya dynasty in the Northern Circars can be inferred from the inscriptions found in the Ganjam and Godavari Districts, and a revised genealogy of the Kona-Haihaya chiefs of the Andhra country has been given.

* * *

State Aid to Industries.—A review of the efforts that have been made by the Government of India to stimulate industries, has been published as a *Bulletin* of the Industries and Labour Department of the Government of India. The review covering the period 1928–1935 has been prepared by Mr. N. Mahadeva Ayyar, I.C.S., and forms a sequel to a similar review "The State and Industries" by Mr. A. G. Clow for the years 1920–1928.

Technical and Industrial Education.—The stress of unemployment among the middle classes has brought home to parents and sons alike the increasingly small value from the pecuniary point of view of the purely literary type of education imparted in schools and colleges and the imperative necessity of seeking new fields of employment in the industrial world. The gradual development of industry has steadily widened the effective demand for the services of those who have received industrial training and has thus stimulated the expansion of schools and colleges to meet the need. A large number of technical and industrial schools have come into being throughout India and numerous scholarships have been instituted to encourage students.

Cottage Industries.—The Handloom industry is not confined to the class of hereditary weavers. It provides a subsidiary occupation to the agriculturist at the season when work on the field is slack. In order to develop this industry, the Government of India decided to spend to the extent of 5 lakhs of rupees every year for a period of 5 years, and schemes were formulated and discussed. These schemes provide for improvements in marketing, appointment of technical experts and supply of materials at cheap rates. Similar action was taken by the Government with a view to assist the silk industry, and an annual grant of Rupees one lakh for five years—1935-40–was made. An Imperial Sericultural Committee was set up, which met in 1935 to scrutinise schemes submitted by local governments. More recently, the Government has taken an important step to aid the cottage and small scale woollen industries by making a special grant of Rupees five lakhs spread over five years and a Special Woollen Industry Committee has been set up to advise the Government of India on the question of allotments. The crux of the problem of developing cottage industries is to find a suitable market for the products. Accordingly, the question of efficient marketing organisation for

handloom products was thoroughly studied and promising schemes based on co-operative effort have been adopted. An important feature of the development of cottage industries is the exhibitions organised by Government departments. Besides these, numerous publications have been ushered in, to disseminate commercial intelligence and useful surveys of different industries are being undertaken.

The Governments of Madras, the Punjab and the United Provinces have made several successful efforts to develop the hydro-electric resources of the country, thus making provision for cheap power for industrial consumers.

One of the most outstanding events of the period under review has been the establishment of the Industrial Research Bureau, by the Government of India, which has already undertaken a heavy programme of work and is contributing valuable observations on industrial methods.

The record also deals with the fiscal measures adopted by the Government for assisting industries. Among articles receiving protection are paper, salt, matches, wheat, silver thread and wire, silver plates and like manufactures, magnesium chloride, etc. The policy regarding iron and steel, cotton and other textiles, and sugar is also dealt with. The Government is further affording all possible encouragement to the development of industries in India by giving a definite preference in making purchases for articles of indigenous manufacture.

An exhibition of Indian manufactured articles has been organised in the Imperial Secretariat Buildings, New Delhi, for bringing prominently to the notice of indenting authorities and the general public the standard of quality attained in certain industries.

* * *

Nature reports that **Dr. John Henry Hutton** well known in India as the author of the monumental *Census Report* of 1931, has been appointed a Lecturer in the Faculty of Archæology and Anthropology in the University of Cambridge for a period of three years as from October 1st. Dr. Hutton entered the Indian Civil Service in 1909 and during the 27 years of his service he had ample opportunities to come into contact with the peoples of India. He made a special study of the ethnography of the Nagas of Assam, the results of which study have been incorporated in two monographs published under the auspices of the Government of Assam. His *Census Report* published in 1933, is a remarkable document which has ensured for him a prominent place among the scientists as an expounder of the racial history of India. He was General President of the Indian Science Congress, 1935, and President of the recently formed Indian Anthropological Institute.

* * *

Malaria and Nutrition.—*Nature* announces that at a meeting of the Council of the Royal Society held in July, it was decided that the whole income together with the invested income of its Medical Research Funds should be employed for a period of 5 years on a scheme of laboratory research on Malaria to be conducted in England, and a field enquiry into malnutrition in India. Lieut.-Col. J. A. Sinton, lately Director of the Malaria Survey of India, has been appointed to conduct the first part of the malaria programme. He will work in the laboratories of the Malaria Therapy Centre at Horton,

Dr. Curgel Wilson has been appointed to conduct the Malnutrition Survey of India in collaboration with Dr. Aykroyd, Director of the Nutritional Research Institute, Coonoor. The problem of malnutrition in India is one of the major problems (see *Current Science*, 1935, 4, 75) requiring immediate attention and it is hoped that the survey which will be concerned chiefly with the incidence of malnutrition among school children and the dietary habits of groups of families in the districts where the children live, will be to the lasting benefit of India.

* * *

Dr. H. S. Rao of the Zoological Survey of India received a specimen of *Hippocampus kuda* Bleeker, 6 inches long from the vicinity of Port Bonnington, North Andamans, where it was collected by Mr. M. Balasubramanian of the Forest Department on the 2nd July 1936. The fish was caught on the southern shore of the Steward Sound not far from Mangrove Island in a fishing net along with sardines in about 3 feet of water over a sandy bed. According to the information supplied by the collector the local Andamanese know this fish casually and only from deep water, while the Burmese settlers believe that paste made with this fish is an antidote for snake and centipede venom.

This sea-horse is a littoral species widely distributed along the tropical coasts of the Indian and Pacific Oceans as far east as the Hawaiian Islands north of Japan. The observation that a paste prepared from the "Godha machi" (*Hippocampus*) is an effective cure for snake or centipede bite is new and well worth recording.

* * *

Nitrogen Transformations in the Soil.—Addressing the *Society of Biological Chemists*, at Bangalore, on "Nitrogen Transformations in the Soil," Prof. N. R. Dhar of Allahabad stressed the importance of molasses as an effective means of increasing the nitrogen content of Indian soils, which as a class are poor in this essential constituent when compared to soils of temperate and cold climates. The excessive heat and moisture of the tropics which account for the rapid depletion of soil organic matter and loss of nitrogen, could be utilised to help nitrogen fixation and augment the nitrogen reserves of the soil through the application of molasses. In the rapid photochemical and bacterial oxidation of molasses, large amounts of energy are set free, which result in the production of ammonia and nitrates. Application of molasses 2 or 3 months before sowing and subsequently ploughing 3 or 4 times, has been found to give greatly increased yields from rice, sugarcane, etc. Another important observation of Dr. Dhar is the great utility of molasses in the reclamation of alkaline soils. In this respect, molasses appears to be more effective than gypsum or powdered sulphur and requires a much shorter time to show results. Alkaline lands have been successfully reclaimed in different parts of the United Provinces and of Mysore by the application of molasses and crop yields obtained where no vegetation grew before.

* * *

Manufacture of Liquid Chlorine in India.—Under the auspices of the Technological Association, University of Bombay, Mr. G. S. Gulrajaney read a paper on 'The Possibility of Liquid Chlorine Manufacture in India,' on the 28th September. The present demand for liquid chlorine

is estimated at 360 tons per annum, valued at 2½ lakhs of rupees. The principle use of liquid chlorine is for bleaching bamboo pulp. About half the quantity is used up in Bombay and there is ample scope for installing a plant, with a daily output of 1,000 to 1,500 lb. of liquid chlorine. The capital requirements for such a concern is estimated at 20 lakhs of rupees and it is expected that it will be able to pay a dividend of about 10 per cent. The product can be marketed at 3½as. per lb., as against 5 as. per lb. at which the imported article is sold.

* * *

The Problem of Trisection of Any Angle.—(By Sri Niwas Asthana).—By using an elaborate set of constructions, the author believes that he has successfully solved a classical problem. His proof, published about two years ago, in the form of a pamphlet was not accepted, and he has now made an attempt to correct the mistake in his proof. Unfortunately, a mistake occurs in the very same place, only under different wordings.

The problem is closely allied to the problem of solving a cubic equation by means of quadratic Surds only, and it is known that the problem is insoluble "if in our constructions we restrict ourselves to the use of circles and straight lines, that is, to Euclidean Geometry" (W. W. R. Ball, *Short History of Mathematics*, p. 37; also refer to J. W. A. Young, *Monographs on Modern Mathematics*, p. 364).

Mr. Sri Niwas Asthana is a schoolmaster gifted with remarkable enthusiasm and "geometrical patience," and would surely be able to do interesting work if he attempts other problems instead of worrying himself about an insoluble problem. C. N. S.

* * *

An important event connected with the recent meeting of the British Association at Blackpool is the amalgamation of the British Science Guild with the Association.

* * *

The foundation of the British Science Guild in 1905 was primarily due to the efforts of Sir Norman Lockyer, the celebrated founder of *Nature*. Lord Haldane was its First President. The Guild's aim is to influence public opinion and to promote closer contact between science on the one hand and social problems and public affairs on the other. Since the Association has also pursued the same aim in recent years it was considered desirable to incorporate the Guild with the British Association.

* * *

The Geological, Mining and Metallurgical Society of India.—The Twelfth Annual Meeting of this all-India body was held at Calcutta, the Society's headquarters, on 24th August. Prof. N. P. Gandhi, the President, delivered an address on India's drift without a mineral policy.

During the year 1935–36, the Society held 8 ordinary meetings for reading and discussing scientific communications, and 9 Council meetings for transacting ordinary business. Among the important steps taken by the Council, mention may be made of the addition of a Review Section to the *Quarterly Journal* of the Society. The Society has kept up its usual level of activity, and its Journal has maintained a high standard. As many as 16 papers were published in the Journal mostly pertaining to Geology. It is hoped that papers dealing with Mining and Metallurgy will find place in the *Quarterly Journal*, the official expositor of the activities of the Society.

* * *

The National Academy of Sciences, India.—At the Ordinary Monthly Meeting of the Academy held on 15th September 1936 the President announced that the Imperial Council of Agricultural Research has made an annual grant of Rs. 500 for a period of three years to the National Academy of Sciences, India, to meet the publication expenses of the Academy.

At the same meeting, Mr. B. K. Bhatnagar, B.Sc. (Allahabad) and Mr. Hrishikesha Trivedi, M.Sc. (Lucknow) were elected Members.

* * *

Calcutta Mathematical Society.—At the meeting of the Society held on the 5th, Mr. H. N. Gangully, M.A. (Patna) and Mr. N. Chatterjee, M.A. (Bankipur) were proposed for election as ordinary members.

* * *

Sir Edward Poulton, Emeritus Professor of Zoology at Oxford, the well-known entomologist and Darwinian, has been elected President by the British Association for the Advancement of Science for 1937. The meeting will be held at Nottingham from September 1 to 8.

* * *

News has been received that DR. B. S. GUHA of the Indian Museum, Calcutta, has been elected a member of the Comite International de Preparation Scientifique of the Institut International D'Anthropologie. He has also been recently elected a member of the Comite Permanent de Recherches pour la Standardisation des methodes anthropologiques of the Congress International Des Sciences anthropologiques and is on the Executive Body of the section dealing with anthropometry.

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Dr. Habib Abdur Hafiz is confirmed as Assistant Superintendent of the Zoological Survey of India.

* * *

Dr. S. S. Bhatnagar has returned to India after his European tour, in which he represented the University of the Punjab at the Empire Universities Conference.

* * *

In the death of **Monsieur Paul Kestner** (*b.* 1864) the scientific world is deprived of an eminent chemical engineer and industrial chemist, gifted with great inventive ability. He was the Founder of the firm of Paul Kestner at Lille, the name of which was subsequently changed to Société Anonyme Appareils et Evaporateurs Kestner. His inventions cover a very wide field; mention may be made of the improvement of lead chambers in sulphuric acid manufacture, fans to deal with corrosive acid fumes, and the well-known Kestner Evaporators. After the Great War, Paul Kestner occupied himself with researches in agriculture and vegetable physiology.

* * *

Announcements:

The King George Thanksgiving (Anti-Tuberculosis) Fund Committee has decided to hold the next post-graduate course for training in tuberculosis at the All-India Institute of Hygiene and Public Health, Calcutta, from the 4th to the 30th January, 1937. The number of students will be limited to 25 as a greater number cannot be dealt with effectively for demonstration and clinical purposes. Selected candidates will be

paid by the Thanksgiving Fund second class return railway fares from their stations to Calcutta and back subject to a maximum of Rs. 100, the balance being met by the candidates themselves or their employers.

Medical men, whether private practitioners or in the service of a government, railway, municipality, etc., are eligible to apply. Applications should be submitted by the 1st November 1936, in the prescribed form, which can be obtained from the Organising Secretary, King George Thanksgiving (Anti-Tuberculosis) Fund, from 20, Talkatora Road, New Delhi.

Applications should reach Dr. A. R. Mehta, the Organising Secretary of the Thanksgiving Fund, by the 1st November 1936. Those received after this date will not be entertained.

* * *

Imperial Council of Agricultural Research.—**Applications** are invited for the award of prizes, *during* 1937, for improvements in *Machinery for Preparing Crops for Market, for Food or for Storage.*

On the 7th June 1933, it was announced that the Imperial Council of Agricultural Research would award annually one Gold and two or three Silver Medals for improvements of distinct merit in the science and art of agriculture and animal husbandry of an all-India importance and that awards would be made each year in one of the five groups, *viz.*, (1) Veterinary Scientific Instruments and Appliances (1934). (2) Dairying and care of animals (1935). (3) Field Implements and Appliances (1936). (4) Machinery for Preparing Crops for Market, for Food or for Storage (1937). (5) Water Lifts (1938).

Entries will be submitted in the first instance to the Provincial Agricultural Research Committees which will forward to the Council those which they consider suitable with a description of entries that have been rejected.

All entries for the award should reach the Secretary, Imperial Council of Agricultural Research, through the proper channel not later than 1st December 1936. Entry forms and the conditions to be fulfilled can be obtained from the Secretary, Imperial Council of Agricultural Research, Simla.

* * *

We acknowledge with thanks receipt of the following :—

"The Agricultural Gazette of New South Wales," Vol. XLVII, No. 9, Sept. 1936.

"Journal of Agricultural Research," Vol. 53, No. 1, July 1936.

"Indian Journal of Agricultural Science," Vol. VI, No. 4, Aug. 1936.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 27, No. 8, August 1936.

Dominion of Canada, Department of Agriculture : National Research Council—

"The Comparative Feeding Values for Poultry of Barley, Oats, Wheat, Rye and Corn."

"The Philippine Agriculturist," Vol. XXV, No. 4, September 1936 and Index for first 20 volumes.

"The Allahabad Farmer," Vol. X, No. 5, August 1936.

"Journal of the Royal Society of Arts," Vol. LXXXIV, Nos. 4370–4374.

"Biochemical Journal," Vol. 30, No. 8, Aug. 1936.

"Chemical Age," Vol. 35, Nos. 895–899.

"Journal of Chemical Physics," Vol. 4, No. 9, September 1936.

"Journal of the Indian Chemical Society," Vol. 13, No. 8, August 1936.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 69, No. 9.

"Journal de Chemie Physique," Vol. 33, Nos. 8–9, August–September 1936.

"Experiment Station Record," Vol. 75, No. 2, August 1936, and Index to Vol. 73.

"Transactions of the Faraday Society," Vol. XXXII, Pt. 9, September 1936.

"Indian Forester," Vol. LXII, No. 10, Oct. 1936.

"Forschungen und Fortschritte," Vol. 12, Nos. 26–27.

Government of India Publications :—

"Monthly Statistics of Production of Certain Selected Industries of India" (Department of Commercial Intelligence and Statistics), No. 3, June 1936.

"Annual Report of the Imperial Council of Agricultural Research for 1935–36."

Indian Meteorological Department, Scientific Notes, Vol. XXIV, Part VI : "Typhoons and Indian Weather."

"Indian Trade Journal," Vol. CXXII, Nos. 1577–1580.

Report of the Haffkine Institute, Bombay, for 1932-35.

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1935.

University of Illinois Publications, Vol. 33, No. 42—"A Study of the Reactions of Various Inorganic and Organic Salts in Preventing Scale in Steam Boilers."

League of Nations Publications—"The Problem of Nutrition, Vol. IV—Statistics of Food Production, Consumption and Prices."

"Marriage Hygiene," Vol. III, No. 1, Aug. 1936.

"Journal of the Indian Mathematical Society," Vol. II, No. 3, 1936.

"The Calcutta Medical Journal," Vol. 31, No. 3, September 1936.

"Medico-Surgical Suggestions," Vol. 5, No. 8, August 1936.

"Electrotechnics," No. 9, April 1936.

"Review of Applied Mycology," Vol. 15, No. 8, August 1936.

International Institute of Agriculture—"Bibliography of Tropical Agriculture, 1935."

"Journal of the American Museum of Natural History," Vol. 38, No. 2, September 1936.

"Journal of the Bombay Natural History Society," Vol. 38, No. 4.

"Nature," Vol. 138, Nos. 3486–3490.

"Journal of Nutrition," Vol. 12, Nos. 2–3.

"Indian Physico-Mathematical Journal," Vol. 7, No. 2, September 1936.

"Canadian Journal of Research," Vol. 14, No. 8.

"Journal of Research, National Bureau of Standards," Vol. 16, No. 2.

"Scientific American," Vol. 155, No. 4, Oct. 1936.

Catalogues:

"Monthly List of Books on Natural History and Science," September 1936 (Messrs. Wheldon & Wesley, London).

"Mitteilungen über Neuerscheinungen und Fortsetzungen," 1936, No. 4, September (Messrs. Verlag von Gustav Fischer in Jena).

"Bell's Miscellany, Autumn Books," 1936 (Messrs. G. Bell & Sons, Ltd.).

"Cambridge Autumn Books, 1936" (The Cambridge University Press).

"Balopticons and Accessories" (Messrs. Bausch & Lomb, Rochester, N. Y.).

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences.

September 1936. SECTION A.—I. Z. SAIYED AND D. D. KANGA: *Chemical Examination of the Fruits of* Solanum xanthocarpum. S. CHOWLA: *Pillai's Exact Formulæ for the Number* g(n) *in Waring's Problem.* N. S. NAGENDRA NATH: *The Visibility of Ultrasonic Waves and Its Periodic Variations.*—A general theory has been developed and it is shown that the periodic visibility is characteristic of any general periodic supersonic wave. R. D. GUPTE: *Distribution of Temperature and Vapour Pressure in the Neighbourhood of a Water-Surface.*—With wind speeds varying from 0 to 2½ metres per second, when the water-surface was warmer than air, there were conspicuous fluctuations of temperature above the water-surface, the maximum fluctuations being at a height of about 1 cm. from the surface. S. SIDDIQUI, R. H. SIDDIQUI AND S. K. SHARMA: *Studies in the Conessine Series. Part II.—Relationship between N-Stability and Pharmocological Action of Conessine and Iso-Conessine.* T. S. WHEELER: *On the Theory of Liquids. Part VI.—The Rate of Reaction in Liquids. Part VII.—Diffusion and Vapour Pressure Phenomena.* S. NIYOGY: *Organo-Metalloid Compounds. Part I and II.*—Stibinic acids corresponding to the trypanocidal arsenic compound "Albert 102," have been prepared and their physiological action examined. V. GANAPATHY IYER: *On the Maximum Modulus Curves of Holomorphic Functions.* CH. V. JOGARAO: *An Optical Investigation of Some Indian Oils. I.—Depolarisation of the Scattered Light.*—The oils studied showed a depolarisation factor of 100% with incident light horizontally polarised, thus behaving as normal liquids. SATYA PRAKASH: *On Non-Spherical Nature of Colloidal Particles in Relation to the Formation of Jelly Structure.*—It is shown that many of the well-known jelly forming sols do not exhibit magnetic birefringence. The case of mercuri-sulphosalicylic acid sol has been studied in detail. C. S. VENKATESWARAN: *The Raman Spectra of Sulphur and Phosphorus. Part I.—Polarisation and Molecular Structure.*—From the polarisation studies, it is concluded that the P_4 molecule is tetrahedral while the S_8 molecule is considered to be a symmetrical puckered ring made up of two squares of four atoms each, one square placed at 45° with respect to another. B. S. MADHAVA RAO: *Ring-Singularity in Born's Unitary Theory—I.*—An elementary particle is considered as a ring-singularity. B. S. MADHAVA RAO: *A Theorem on Action Functions in Born's Field Theory.*

September 1936. SECTION B.—H. R. BHARGAVA: *The Life-History of* Chenopodium album *Linn.*—A fairly detailed description of the life-history of one member of the family of the Chenopodiaceæ has been provided. R. P. ASTHANA: *Antagonism in Fungi as a Measure of Control in 'Red-Leg' Disease of Lettuce.*—The parasitic vigour of *Botrytis cinerea* can be suppressed by a number of fungi of which *Trichoderma lignorum* and *Phoma* sp. are particularly effective. The filtrates of the medium in which these fungi thrive, produce the same effect, thus suggesting that the action is due to staling products. L. RAMA RAO: *The Deccan Traps.*—A brief review of the present knowledge of the Deccan Traps has been furnished and a new interpretation of the mode of their accumulation and biological history given. B. S. KADAM: *Genic Analysis of Rice. I. Grain Shedding.*—Studies on the crossing of a wild rice which sheds its grain completely with a Burmese variety, *Paungbalaung* 3, which is a non-shedder, show that this character is completely dominant and is caused by the duplicate genes Sh_1 and Sh_2. BENI CHARAN MAHENDRA: *On Two Collections of the Ophidian Genus,* Cylindrophis *Wagler.*—The distinctive features generally recognised between the three species of *Cylindrophis* Wagler do not stand the test of a thorough and intensive scrutiny of a representative collection. A new key for this genus is furnished. M. S. RANDHAWA: *Three New Species of* Zygnema *from Northern India.*—The reproductive phase of the three remarkable species of genus *Zygnema* studied shows many peculiarities. M. S. RANDHWA: *A Note on Some Attached Forms of* Spirogyra *from the Punjab.* BENI CHARAN MAHENDRA: *Contributions to the Bionomics, Anatomy, Reproduction and Development of the Indian House-Gecko,* Hemidactylus flaviviridis *Rüppel. Part I.*

The National Academy of Sciences, India:

September 15, 1936.—BINAYENDRA NATH SEN: *On the Direct Formation of Iodides and the Distance of the Closest Approach of Atoms of Iodine.* R. K. SHASTRY: *Theorems Connecting Different Classes of Self-Reciprocal Functions.* RAM BEHARI: *Curved Asymptotic Lines of Ruled Surfaces.*

Indian Mathematical Society:

RAM BEHARI: *Generalisations of the Theorems of Malus-Dupin, Beltrami and Ribaucour in Rectilinear Congruences.*—The generalisations refer to the *pitch of the pencil* at any ray of the congruence,—a concept which has been defined and discussed in a previous paper by the author, published in *Journ. Ind. Math. Soc.*, Vol. I, No. 4. DURGA PRASAD BANERJEE: *A Note on the Zeros of Parabolic Cylinder Functions of the Second Kind.*

$$\text{Let } E_n(x) = \pm e^{\mp n\pi i}\, i\sqrt{2\pi}\,\Gamma(n+1)\times D_{-n-1}(\mp ix)\, e^{-\frac{1}{4}x^2},$$

where the upper or the lower sign is to be taken according as $I(x) > 0$ or $I(x) < 0$, and where $D_n(z)$ is the familiar cylinder function. When x is not real and n is a positive integer, $E_n(x)$ has been shown by Dr. Watson to be equal to

$$\int_{-\infty}^{+\infty} \frac{e^{-\frac{1}{4}z^2} D_n(z)}{z-x}\, dz$$

Mr. Banerjee proves in this paper the following theorem:—

The functions $E_n(x)$ and $E_{n+m}(x)$ have no common zeros, $n+1$ being not a negative integer, and m being a positive integer. V. GANAPATHI IYER: *On Integral Functions of Finite Order Bounded at a Sequence of Points.*—Another

paper extending the results of the previous paper in *Journ. Ind. Math. Soc.*, Vol. II, No. 1. (MISS) S. PANKAJAM: *On Euler's ϕ-Function and Its Extensions.*—The author uses a logical argument developed by Dr. R. Vaidyanathaswamy in his paper in *Proc. Ind. Acad. Sci.*, Vol. II, No. 1, to obtain the values of the familiar $\Phi(n)$ in the theory of prime numbers, and to the generalisaions of this function by Jordan, Schemmel and Lucas. She also works out a further generalisation which will include Jordan's function as a special case. If $J_{rs}(n)$ denotes the number of sets of r integers ($\leqslant n$) whose sth greatest common divisor (a concept introduced by R. Vaidyanathaswamy in his paper *loc. cit.*) is prime to n, then the author establishes that

$$J_{rs}(n) = n^r \left[1 - f_{rs}\left(\frac{1}{p_1}\right)\right] \left[1 - f_{rs}\left(\frac{1}{p_2}\right)\right] \cdots \left[1 - f_{rs}\left(\frac{1}{p_q}\right)\right]$$

where

$$f_{rs}(x) = x^r + \binom{r}{1} x^{r-1}(1-x) + \cdots + \binom{r}{s-1} x^{r-s+1}(1-x)^{s-1}.$$

Society of Biological Chemists, India:

September 1936.—T. R. BHASKARAN: *The Mechanism of Biological Nitrogen Fixation.* (MISS) K. BHAGVAT: *The Digestibility of Caseins in Their Natural and Artificial Environments.* DEWAN BAHADUR SIR T. VIJAYARAGHAVACHARYA: *Agriculture and Population.* A. VENKATASUBBAN: *Some Colloid Chemical Aspects of Paint Manufacture.* M. SREENIVASAYA: *The Present Status of the Spike Problem of Sandal.* DR. N. R. DHAR: *Nitrogen Transformations in the Soil.*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

University of Calcutta:

The Calcutta University has taken on hand the proposal for introducing a degree in architecture. A Committee of the Board of Studies in Engineering has been appointed for drawing up the rules and regulations for the institution of such a degree as also the courses of studies for the same, as an extension of the Intermediate course of studies in Engineering.

Major A. C. Chatterjee, I.M.S., has been invited to deliver a course of lectures as *Basanta Lecturer* of the University for the year 1936 on "The Problem of Malaria in Bengal".

Essays for the award of Basanta Medal for 1936 should be submitted before the 30th April 1937. The subject selected is "Bengali Diet—Its Effects on Health".

Osmania University:

Five Research Scholarships each of Rs. 75 per mensem, tenable for two years have been awarded by the University for Post-M.A. and M.Sc. work this year. Dr. M. Qureshi, Head of the Department of Chemistry, has been appointed Secretary, Board of Research.

Dr. Raziuddin Siddiqi, Professor of Mathematics, at present on study leave in England, has been deputed to attend the London University celebrations as representative of the Osmania University.

Two special evening classes for the teaching of Arabic and Sanskrit have been started this year, for the benefit of the students, members of the staff and the public from outside. Dr. Hamidullah, M.A., LL.B., Ph.D., is conducting the Arabic class while Pandit Harihar Shastri takes the Sanskrit class. Separate classes for the teaching of German and French have been in existence for a number of years in the University.

A Music Association with Professor M. Saiduddin, Head of the Botany Department, as president has been formed with the object of encouraging the cultivation of music among the students of the University.

The Pro-Vice-Chancellor has appointed a Board with Dr. Mir Valiuddin of the Philosophy Department as Secretary, for giving advice to the students seeking to appear for competitive examinations for Hyderabad and All-India Public Services.

The University has suffered an irreparable loss in the death of A. H. Mackenzie, Esq., M.A. D.Litt., C.S.I., C.I.E., its Pro-Vice-Chancellor, which occurred in Scotland on Saturday, the 26th September 1936, after an illness of about six months. When the news of the sad death was received in Hyderabad on Monday the 28th September all the institutions of the University were closed and the staff and the students assembled at a condolence meeting where a resolution expressing feelings of sorrow and sympathy with the bereaved family was passed.

University of Mysore:

Extension Lectures.—Dewan Bahadur Sir T. Vijayaraghavacharya, K.B.E., delivered a lecture on "The League of Nations—Its Future" at Bangalore and at Mysore.

Faculties.—The following have been elected Deans of the reconstituted faculties:—

Faculty of Arts: Mr. V. L. D'Souza; Faculty of Science: Mr. K. S. K. Iyengar; Faculty of Medicine: Mr. S. Subba Rao.

Central Advisory Board of Education:

Mr. V. N. Chandavarkar, Vice-Chancellor of the Bombay University, has been elected member of the Central Advisory Board of Education by the Inter-University Board in the place of Sir S. Radhakrishnan, resigned.

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